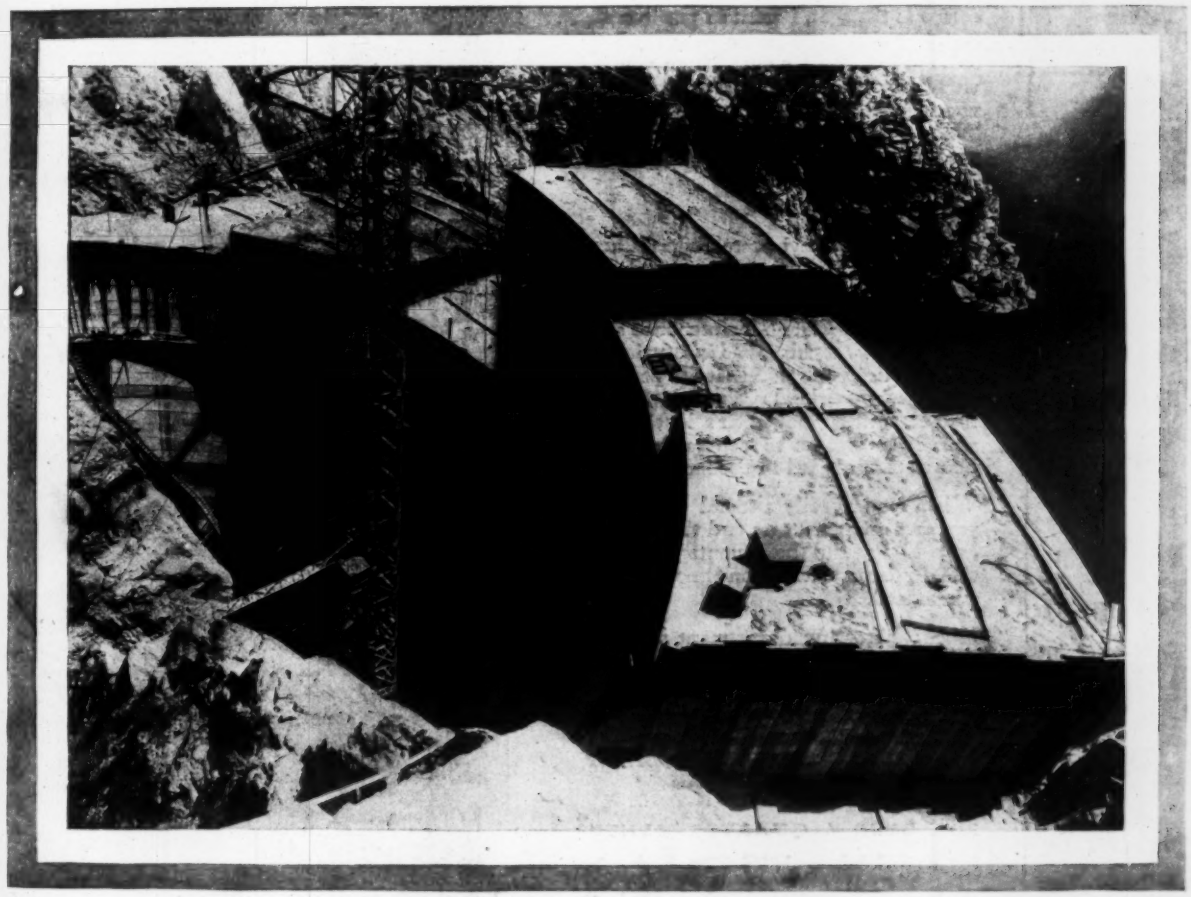
AUG 6 1927

Engineering News-Record

Devoted to Civil Engineering and Contracting. McGraw-Hill Publishing Company, Inc.

August 4, 1927



Pacoima Dam, 385 Ft. High, Under Construction for Los Angeles County Flood Control

Movement of Mokelumne Pipe Line During Construction

Building a High Concrete Arch Dam in a Narrow Canyon

Traveling the Air in Germany

Highway Maintenance by Contract—Third Article in Series

"I Want The Same Roof That's On That Old Boiler House"

"THE layout for the new foundry is all right" continued the president of one of America's leading corporations. "When it comes to the roof, I want to put in a word. See that old boiler house over there. The roof has been on for over fifteen years and we've never spent a dollar for maintenance. I want that kind of a roof on our new foundry." "Why that's the type of roof I intend to use on the new foundry" said the architect. "It's Federal Tile."

* * * *

Through twenty-five years, Federal Cement Tile Roofs have been making good under the most severe conditions.

Their trouble-free, no-maintenance service on thousands of public and industrial buildings has demonstrated that for permanent construction, Federal roofs are lower in cost than any other kind. Their scientific design adds light weight to concrete's strength. Less steel is needed in the framework.

When you specify Federal Cement Tile you save on initial cost, and there is no upkeep. You secure the advantage of installation by experts with on-time completion guaranteed.

Our engineering department will gladly submit recommendations for the most economical layout of both roof and steel. There is no obligation.

Made, Laid and Guaranteed by
FEDERAL CEMENT TILE COMPANY
608 *South* Dearborn Street
CHICAGO

FOR OVER A QUARTER CENTURY

FEDERAL
CEMENT TILE

A Consolidation of Engineering News, Engineering Record and The Contractor

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

McGraw-Hill Publishing Co., Inc.
JAMES H. McGRAW, *President*
E. J. MEHREN, *Vice-President*

FRANK C. WIGHT
Editor

Volume 99 NEW YORK, AUGUST 4, 1927 Number 5

A Practical Suggestion

THERE is both wisdom and practical sense in a call sounded by Major R. W. Putnam, new president of the Western Society of Engineers, for co-operation among engineering organizations. He suggests that the scattered activities of many societies and local sections of national societies cannot accomplish what might be achieved through co-operation, whether in the technical field or in that of public affairs. Obvious as this is, its restatement is valuable. The responsibilities of engineering societies are growing apace, as we pointed out recently, and more efficient conduct of the societies is becoming essential, in some quarters rather urgently so. A marked improvement in the service value of societies may be realized through hearty co-operation, and simultaneously the weight of engineering opinion can be made vastly greater. Even aside from this, however, some very useful practical ends may be attained, chief among them a mutual stimulation of the several organizations in respect to degree of activity as well as efficiency. There is reason to fear that today the individual society member does not always obtain adequate return for his dues and his contribution of time and thought to his societies. He would be assured of a better return if co-operation were in full practice, particularly among sectional groups and strong local technical organizations.

Contract Road Maintenance

CONTRACTORS in the last few years have been casting their eyes toward the opportunity for business offered by highway maintenance. The enormous and still growing expenditure for public roads upkeep is the attraction. Also there is the encouragement of precedent. It has been a common practice, in the past perhaps more than at present, for cities to let contracts for street maintenance. In certain kinds of rural road maintenance work, as for example road oiling, contract work has been common. By and large, however, the upkeep of highways has been held to be the task of the state or county employing its own plant and workmen. Enormous outfits of equipment and large organizations have as the result come into existence among bodies for carrying on the services of government. Large state road systems often engage working forces of thousands of maintenance employees. The contractor sees in this situation both a loss of opportunity for work and a threatening extension of government into business and desires a check on both. His contention is that much maintenance work now done by state employees could be done as well or even better by contract. The question is: How much and what kinds? Obviously certain regular maintenance operations do not adapt themselves to the requirements of public works contract practices. Where is the dividing line between such, logically, force-account operations and others which can be carried on by contract? The question is vital to the contracting business and the serious and intelligent attempt in this issue by the director of public works of a great roadbuilding state to answer it is deserving of the fullest consideration. The author of the article approaches his subject with an openness of mind difficult for the government officials always to attain. He asserts with equal frankness both wherein, he thinks, contract maintenance is a success and wherein it cannot succeed. He is essentially fair. For this reason both contractors and public roads officials will find much that they can well heed in the facts and reasoning presented.

Surety Bonds Again

SURETY bond practices are again under fire from public works officials in New York. This time the city of New York through the Board of Transportation is making charges of unfair practices in the bonding of subway contractors. A year ago, as was fully noted at the time in these columns, it was the state architect, Sullivan W. Jones, who led an attack which resulted in an investigation under the Moreland act and finally decision upon the hearings by the state superintendent of insurance to reduce the premium on bonds for state work from 2 to 1 per cent. The present dispute assumes a somewhat different aspect although it is traced to the extension recently by the superintendent of insurance to city subway work of the previous ruling for state work. Under this ruling, it is alleged by the Board of Transportation, the surety bonding companies are declining to bond contractors recently awarded subway construction contracts. The situation as it has so far presented itself is outlined in the current news section of this issue. Beyond the general relation of the charges now being made to the long standing controversy between organized contracting and the corporate surety bonding interests the present situation stands out by the decision to allow subway contractors to give 5 per cent collateral surety instead of a 10 per cent surety bond, and by the announcement that an investigation of surety bonding practices will be instituted at once by the Board of Transportation. It may be doubted if much that is tangible fact will come out of the charge of a "bond ring," whatever the truth may be, but the bad influence of modern surety bonding practices on contracting makes desirable any questioning which may bring the conditions into the light.

Excess Condemnation and Better Housing

EXCESS condemnation, or the taking of more land than is needed for street widening or extensions, parks or other public improvements, has been practiced but little in the United States compared with foreign countries, although having had earnest advocates here. Obstacles to use of excess condemnation in America have been general conservatism and fear of attack on state constitutional grounds. To obviate the latter, New

York State adopted a constitutional amendment authorizing the practice, and New York City, in 1916, incorporated an excess condemnation provision in its charter. The latter now proposes to use these provisions to facilitate large housing schemes of private but semi-philanthropic character, outlined in our news section. To this end the Board of Estimate and Apportionment has taken two steps, one by itself alone and another as a constituent of the Municipal Assembly—the other branch of which is the Board of Aldermen. The first step is, in effect, a declaration that in future condemnations of land for public purposes consideration shall be given to excess condemnation to facilitate the diminution of "so-called slum districts and promoting [better] housing condition"—the latter to be effected by leasing the excess land condemned as sites for low-rent apartments. The second step is merely to facilitate action in accordance with the first one. Adoption of the excess condemnation by New York City is interesting both in itself and as an aid to better housing.

Buses and Road Structure

MOTOR buses now traverse upwards of 270,000 miles of public roads in the United States. This is some 13,000 miles more than the total railway mileage. All buses number about 80,000 and last year they carried 2,395,000,000 passengers and traveled almost 2,000,000,000 miles. The authority for these figures is the American Automobile Association whose little book, "Bus Facts," gives numerous summations and analyses breaking down the totals in many ways. It is not as a record of bus development or of motor bus traffic, however, that the figures are given attention here, but as an indication of the demands which this development and traffic are making on the highway engineer. The fact that the public roads official recognizes the economic and social justification of bus transport on the highways makes his problem no simpler. He has to design and rebuild for a vehicle which puts a demand on roads quite different than do other kinds of traffic—a demand for greater lateral dimensions. The 30-ft. bus with its 21-ft. wheelbase requires road width and curve room. The pavement that holds up a motor truck will hold up a bus but the traffic room required by the bus is far greater. Concisely, the motor bus has put upon the road engineer the problem of providing roomier roads. It has given him a traffic control problem also and a difficult one, but the problem of road structure is the more intractable. With road costs as great as they are it takes engineering courage to plan wider roads and call upon the public to pay the price. And every year more roads are becoming bus routes.

Motor Trucks and Freight Terminals

THE design of piers at Los Angeles harbor has been changed very materially to facilitate handling the increased percentage of freight shipped to and from that point by motor trucks. Indeed, the movement of 60 per cent of general cargo and lumber at these terminals by motor trucks warrants placing paramount importance on their needs provided this percentage is stable and does not represent some emergent or temporary situation. A paper presented this month before the Pacific Coast Association of Port Authorities by George F. Nicholson, harbor engineer, city of Los Angeles, and noted elsewhere in this issue, cites a steady increase in the percentage of motor truck haulage at that port for more than three years but concludes that the present percentage of truck haulage is not likely to increase materially. Mr. Nicholson goes so far as to express an opinion that it will be safe to design the average terminal facility there with a view to handling approximately 60 per cent of all intercoastal (Atlantic to Pacific, via Canal) and foreign cargo, and 20 per cent of all coastwise cargo by trucks. Conditions at Los Angeles are peculiarly favorable to motor truck haul; the large mileage of hard surface highways within a 200-mile radius; the mild winters and relatively low truck operating costs are all factors. For example, practically the entire cotton crop of Imperial Valley has been moved by trucks to this port, a haul of some 220 miles. These points indicate an unusual situation and Mr. Nicholson is to be complimented for having carefully analyzed it and adapted the design of new piers accordingly. While it is unlikely that the same conditions would obtain elsewhere there is in this case a valuable suggestion for the harbor engineer of any American port, namely, that it is well to make periodic analyses of the relative percentage of freight movement by rail and by motor truck. A terminal is not properly equipped unless it provides for effective handling of freight for that means of transportation that is found most economical under local conditions, and these conditions sometimes change rapidly.

Water Meters and Politics

CONTINUING his political stand against the ordinance which provides for universal metering at Chicago within ten years, Mayor Thompson has had an ordinance introduced in the city council which would eliminate the use of meters in residences although requiring that large consumers be metered. This scheme it is proposed to supplement by a water-waste survey and leakage-stop campaign. According to the attorney who drew the new ordinance, this survey and leakage work would cost about $6,000,000 and be distributed over five years. It does not appear on what basis the amount is arrived at. Presumably it is an arbitrary assumption.

When this ordinance was presented to the finance committee on July 25, it was claimed verbally that the new plan is acceptable to the U. S. government, but objectors demanded a written statement to that effect from some War Department official. There was also a demand for more definite information on the financial aspects of the subject. The net result of the discussion was to postpone consideration of the ordinance.

This is the mayor's second attempt to defeat the metering program, as the council's finance committee has had before it for months an ordinance to repeal the present meter ordinance introduced at the instance of Mayor Thompson the day he was inaugurated, in accordance with election campaign promises. The existing ordinance was passed by the city council in September, 1925, on demand of the War Department as a condition for a permit for a draft of 8,500 sec.-ft. from Lake Michigan by the drainage canal, pending the decision in the case now before the courts as to the diversion of lake water by the canal.

It may be doubted whether the proponents of the new ordinance have much knowledge of the value of the proposed alternative method of checking Chicago's extravagant use and waste of water, with its consequent

needless expense and inadequate supply in certain parts of the city. It has been shown that more than 50 per cent of the water pumped is wasted, while more than 50 per cent of the consumers are deprived of an adequate supply. Several water-waste surveys made under the direction of the late John Ericson, as city engineer, disclosed widespread waste, but very little remedy followed the disclosures. When under the present flat or fixture rates water is wasted wholesale by inmumerable faucets which are allowed to run continuously for coolness in summer and to prevent freezing in winter, no political water-waste prevention force is going to be effective. Only recently, the failure of water to reach the upper stories in certain districts has been laid to the continual lawn sprinkling during illegal hours.

In the propaganda against universal metering, absurd statements are made. An alderman who is reported as foreseeing military action by the War Department if the city refuses to install meters, is quoted as saying: "Think of that: Bayonets to keep the babies from getting pure water." This illustrates the caliber of the opponents of the meter system. Based partly on the illogical idea that water should be "free as air," there has been for years in Chicago a strong objection to universal metering. This objection has been made the most of by political demagogues. In their attitude on this question and their consequent attack upon the public health, wealth and welfare, these Chicago "free water" officials may be classed with those of Montreal who tried to handle a serious typhoid epidemic by denying its existence and suppressing reports of its deadly progress.

Flood Crests in Rivers

STUDY of a little understood subject, the movement of flood crests in rivers, is to be undertaken by the Federal Power Commission. The study will be directed towards that phase of the subject which is of special interest in power development, the rate of progress of flood crests caused by the sudden release of water in starting up a hydro-electric plant on any stream where much of the water is ponded and used intermittently. Little is known about this except that such flood waves or crests travel long distances with little loss of intensity when the water is discharged into a channel which has so little fall as to be, in effect, a long narrow pond; also that the shape of the channel does not appear to affect the rate of advance but does affect the rate of rise.

A more exact knowledge of these movements is needed in planning the complete development of our water power resources and in integrating power and navigation plans. Most of the knowledge must be gained by the slow process of studying data which can be obtained on streams where a number of developments are grouped one above the other and where each plant discharges its water into the upper end of the pond of the plant below. Studies also must be made to determine the rate of flow of such flood crests in natural channels because many streams possibly never will be fully developed and the probable rate of flow from plant to plant in such streams must be known before an economical operating program can be made for them. The subject is one which does not lend itself to experiments with models. Results of actual practice must be collected and interpreted. Engineers of the Federal Power Commission and of the Geological Survey are in an excellent position to carry on this important work.

More Naval Bureaucracy

SAN FRANCISCO wants governmental sanction for the construction of a bridge across San Francisco Bay on the Rincon Hill-Alameda Mole site selected by a board of consulting engineers, but for the present is blocked in going farther with the project by the determined opposition of the navy. The admirals who recently passed on the application reiterated a decision of the department made in 1921 disapproving any bridge north of Hunters' Point. These admirals suggested moving the proposed location south to Hunters' Point so as to meet naval anchorage needs more adequately. This is in line with the navy's policy as stated in rulings on applications for bridges elsewhere.

The navy sees no objection, in the San Francisco case, to detouring permanently a heavy and continuous flow of traffic five miles south on the west side of the bay and, after making a longer crossing, bringing it back a still greater distance on the east side, all in order to suit departmental ideas about the "naval anchorage," an imaginary line enclosing a usually vacant space whose chief reason for the particular location it now occupies on naval charts is convenience in getting Jack Tar on land for shore leave and delivering supplies to the ships. Deep water extends for miles up and down the bay from the present naval anchorage, and if a naval base is ever constructed at Alameda its bay frontage would not be obstructed by the bridge. The grounds for objection, if they may be so called, as advanced by the admirals are insignificant and unreasonable as compared to the urgent need for removing a handicap to civic development in a large community.

Any public service commission would grant a certificate of convenience and necessity for this bridge on the showing that last year 2,700,000 vehicles and 45,000,000 passengers crossed the bay on ferries near the proposed bridge site. The wait incidental to intermittent ferry service and the delays in times of fog, not to mention the limited capacity of even a very large fleet of ferries, are such serious limitations to the progress and development of a community that no unreasonable objection to a bridge can long prevail. The question of whether it is now feasible to finance the proposed bridge cannot be answered until there is some definite basis for estimating its cost, i.e., until the foundation has been tested by borings. Borings are estimated to cost $250,000 and this sum will not be forthcoming unless approval for this location is secured.

Plans are now under way to carry into Congress the fight to overrule the navy's objection and eventually this bridge and also other bridges on San Francisco Bay will be built. But it is unfortunate that the navy's opposition should be added to the other problems of financing and building. It is well enough for the navy to protect its own interests, but being an interested party it should be required to appear as such before an impartial tribunal and should not be in a position to pass judgment. When an interested party to any controversy sits as judge there is strong temptation to bureaucracy—something which the people of this country, not being militaristic, will not long endure. Important bridge applications should be decided by a commission representing the departments of commerce, agriculture and war, as was done recently in the application for a bridge over the Columbia River. Before such a commission the navy, like other partisans, will get a fair hearing and all can expect a fair decision.

Building a High Concrete Arch Dam in a Narrow Canyon

Construction Plant at Pacoima Dam, Near Los Angeles, Planned to Fit Space Limitations and to Require Few Workmen

THE PACOIMA dam which is being built in the mountains four miles above San Fernando, Calif., as part of the Los Angeles County Flood Control project, is notable because it will have a total height of 385 ft. Its construction is of interest because of the effective way in which the contractors have laid out their plant in the restricted space of an extremely narrow, tortuous canyon. Automatic and mechanical features have been developed to a marked degree so that the operating force required is comparatively very small.

The keynote of the policy under which this job was organized as a construction venture was expressed by Stanley Bent of Bent Bros., as follows: "The objective was to get the plant as a whole as near perfectly balanced as possible from the gravel digging unit to the spouting system on the dam. Any one of the men in charge of one operation feels that he can, by hurrying a little, bury the man in charge of the next operation, but this never happens. Each unit is working nearly to its limit, but there is just enough flexibility so that if there is a slight increase in one part of the work the others can step up enough to meet it. There is the most flexibility in the tramway and this flexibility together with our storage at different points enables us to balance production and consumption very nicely. All of which only emphasizes the importance of carefully analyzing all the elements of the job in making the original layout."

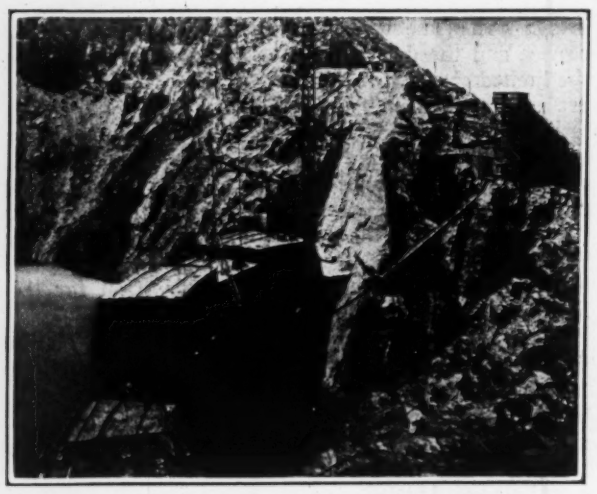


FIG. 1—VIEW ACROSS THE CANYON AT PACOIMA DAM
Mixing plant in background is at the top of the incline.

The dam is on Pacoima Creek, a small tributary of the Los Angeles River having a drainage area of only 28.2 sq. miles (storage capacity 12,000 acre-ft.), but storm waters in the box-like canyon have repeatedly taken toll during construction. Equipment, camp buildings, the canyon road and bridge were washed out or buried by débris more than once; and in April, 1926, when the excavation had reached its lowest depth, the foundation excavation was entirely filled with débris carried down by flood waters. Because of the flood danger, as little construction equipment as possible has been put in the canyon bottom and the unavoidable flood delays in no wise changed the plan of operations.

The total excavation amounted to about 100,000 cu.yd., of which the most difficult portion was the clearing off of shattered and seamy material overlying suitable abutment rock in the canyon walls. These walls are so steep that workmen had to use safety belts fastened by long ropes to pegs driven in drilled holes in the rock and were taken to and from their stations by a skip operated on an overhead cableway. The excavation in the bottom of the canyon was not great as the gorge at the dam site was only about 40 ft. wide at stream-bed level. The lowest concrete was poured about 12 ft. below stream bed. The dam is a constant-angle arch and will contain a total of 225,000 cu.yd. of concrete. Due to the shape of the canyon, successive horizontal sections of the dam have almost equal areas; that is, as the dam is being built up the increasing length compensates for decreasing thickness in such a way that the concrete yardage per foot of elevation does not vary greatly between stream-bed and crest levels.

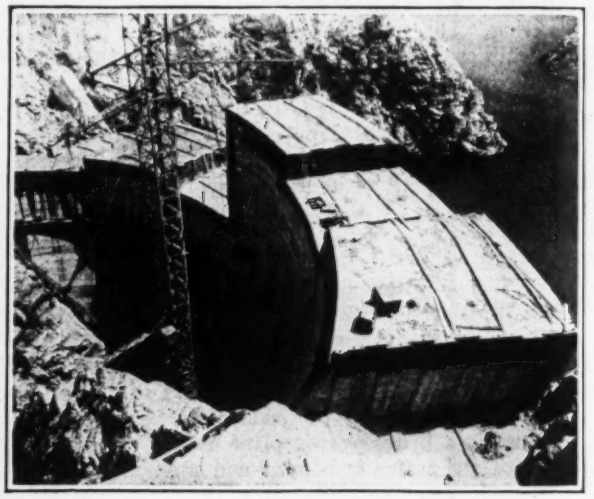


FIG. 2—LOOKING DOWN ON THE DAM FROM SOUTH ABUTMENT
Dam had been brought up to half total height at this time.

Sand and rock suitable for concrete were found in the stream bed about 3,500 ft. below the dam site and here there was set up an aggregate plant containing two rock crushers, screens and sand washing equipment. Material from the gravel pit is loaded by a 1¼-cu.yd. gasoline shovel into cars that are hauled up an incline to dump into crushers at the aggregate plant. Specifications call for a concrete mix with three sizes of rock, the proportions being one part cement to 2½ of sand and

5 of rock, in sizes from one to 2½ in., and plums up to 1½ cu.ft. The use of plums was optional with the contractor, who decided to use nothing larger than 4-in. rock and this was run through the mixer.

The plant segregates materials of these sizes from the pit run, and by careful selection on the part of the pit foreman, it has been possible to control the proportions

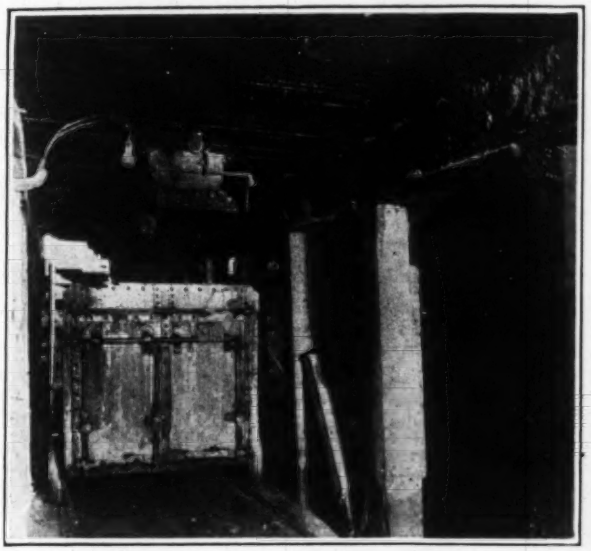


FIG. 3—LOADING MATERIALS AT BOTTOM OF INCLINE
Incline track shows in background. Note arrangement of trap doors.

of the pit run so that very little waste material is taken out. In fact, after the removal of the 100,000 cu.yd. handled up to May 1, the segregated material remaining in stock piles at the plant, i.e., the unbalanced production, totaled only a few hundred yards. Even this, being good material, is regarded as a convenient margin in case the pit run should need to be supplemented to obtain the required proportions.

Materials go from the aggregate plant to the bunkers at the foot of an incline tramway by motor truck, a subcontractor operating a fleet of trucks in this service. The same contractor hauls in cement from the railroad at San Fernando, 4 miles away; thus one man is responsible for all but a small percentage of the tonnage to be hauled to the job. Two features of this hauling contract are notable: (1) the hauling contractor is made responsible for the upkeep of the roads that were built expressly to serve the job and is required to do all road maintenance that may be necessary; (2) he is paid for the hauling on the basis of yardage of concrete actually put into the dam. This arrangement allocates concern about road upkeep to the principal user of the road and eliminates much unnecessary checking of materials by truckloads. Under this plan the contractor may load his trucks light or heavy, as he pleases, and works under the one requirement of delivering material to bunkers at the bottom of the tramway leading to mixing plant as fast as it is needed. Incidentally the aggregate averages about 2 tons per cubic yard of concrete in the dam.

The San Fernando cement warehouse can store about 7,500 sacks of cement and there is space for a like amount on the job, about 3,000 sacks at the bottom of the incline, and 5,000 sacks at the mixer plant. The capacity of the material bunkers at the aggregate plant is about 400 cu.yd.; at the bottom of the incline about 300 cu.yd.; and at the mixing plant about 200 cu.yd. This proportioning of capacities and storages was worked out with a view to maximum protection, within economic first cost limitations, against delaying the placing of concrete due to interruptions in deliveries.

The incline tramway has a length of 700 ft., a vertical lift of 300 ft. and a maximum slope of 45 deg. It has two tracks and on it are operated two 4½-cu.yd. cars, the cables being so wound on the drum of a 200-hp. hoist that one car goes up as the other comes down. At least during some stages of construction, this incline is the "neck of the bottle" in maintaining a service of supplies to the mixer. The mixing plant and the concreting crew work one 8-hr. shift out of 24. The tramway, on the other hand, has to operate two 8-hr. shifts to deliver enough cement, sand and rock for the 500 cu.yd. of concrete that the mixing plant can ordinarily pour in one 8-hr. shift. Cement is brought up on the second shift after sufficient sand and rock have been hauled to fill the bunkers at the top of the tramway.

The gates in the bottoms of the bunkers at the mixer plant deliver a measured charge when the lever on the tripping device is thrown by the car as it comes into position under the bunkers. Four bunkers are used, one for sand and one each for the 1-in., the 2½-in. and the 4-in. rock. A single car, operated by a high-speed

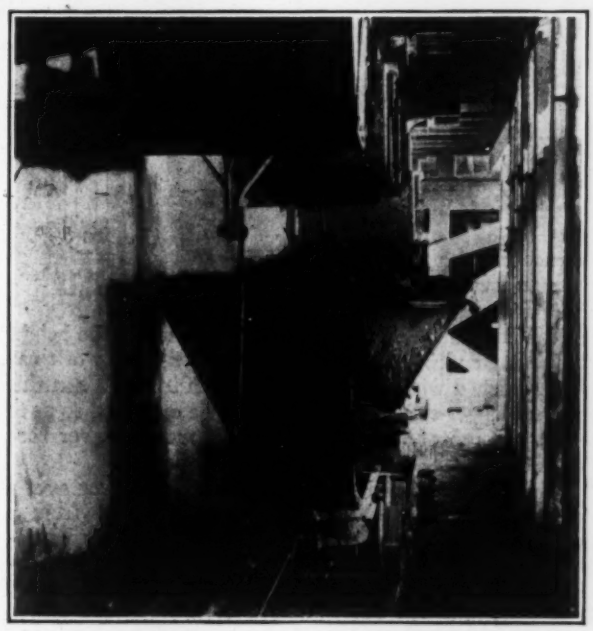


FIG. 4—LOADING AGGREGATE INTO CONCRETE MIXER CAR
Note gate tripping rod, hinged to swing up when car returns toward mixer.

motor-driven hoist, moves back and forth on a straight, level track between bunkers and mixer. The car to be loaded with aggregate for the mixer is stopped successively under the three rock bins where it throws the tripping device as it comes into position; a similar stop is then made under the sand inundator which is dumped by hand after which the car is ready to discharge into the mixer hopper.

One man operates the motor that moves the car to and fro, a second refills the measuring hoppers after each delivery to the car, a third man spends his entire time loading and dumping the sand inundator, and a fourth dumps the car into a mixer hopper. With four men on the

cement floor handling and dumping cement sacks and a single man operating the two concrete mixers, the entire crew at the mixing plant consists of nine men.

Two 1-cu.yd. concrete mixers are used and they actually discharge 1.2 cu.yd. per batch. Each batch is turned for a full minute and a half after all materials have been delivered to the mixer. Time for loading and dumping brings the average time for each delivery up to 2 min. Operations in the mixing plant have been so co-ordinated that this rate of delivery is maintained for long periods and 500 cu.yd. per 8-hr. shift is a total figure frequently attained. With the rates and capacities mentioned and assuming not an instant's interruption during the 480 min. of one shift, the maximum delivery possible would be only 576 cu.yd. In order that one operator shall perform all the operations required in charging and discharging the two mixers at the 500 cu.yd. rate it is necessary that successive operations in each of the two mixers be timed to a nicety. The necessity for observing exact timing in order to avoid interrupting the schedule is doubtless an incentive to careful co-ordination of the mixer-charging operations.

Tests on the concrete after 28 days have been running 3,200 to 3,400 lb. per square inch.

From the mixer the concrete flows down a chute to the steel tower in which it is hoisted to the suspended spouting system. The tower is of standard construction with the first chute section swung from a boom. The tower base is 150 ft. above stream bed and was built first only to part of the height to be used ultimately. The first half of the work has been finished with a tower height of 200 ft. When this will no longer suffice, the height will be extended so as to bring the top of the tower 420 ft. above the tower base or 570 ft. above stream bed.

Chutes supported from the tower boom deliver over a 100-ft. radius or to another chute suspended from a cable a short distance to one side. By means of a counterweighted arm, this suspended chuting system gives another 150-ft. radius. This overhead cable was erected expressly for carrying the concrete spouting system and the counterweighted chutes suspended from it make it possible to deliver directly to all points on the dam crest, which has a length of 600 ft.

The cables that support the concrete spouting system are in addition to the cableway previously mentioned which was the first one erected and which was used for handling men, forms and equipment. This cableway has a capacity of 2 to 3 tons and was located directly over the steel tower so it could be used in the erection of that structure.

The dam was designed by the Constant Angle Arch Dam Co. of San Francisco and is being erected under the general supervision of the chief engineer of the Los Angeles County Flood Control District. The construction equipment layout was planned and the dam is being built by Bent Bros., Los Angeles, for whom Frank C. Livingstone is superintendent in charge of the job.

Standard Survey Monuments for Harbor Line Work

Markers of Five Types Developed by the U. S. Engineer Department Especially for the Cincinnati District

By C. E. Hammell,
U. S. Engineer Office, Cincinnati, Ohio

IN CONNECTION with a resurvey of harbor lines in the Cincinnati Engineer District, the need for standardization of monument markers has necessitated a study of the various types now in use by the United States Government departments and other agencies, with a view to the development of a marker which will embrace those features best serving the needs of the district.

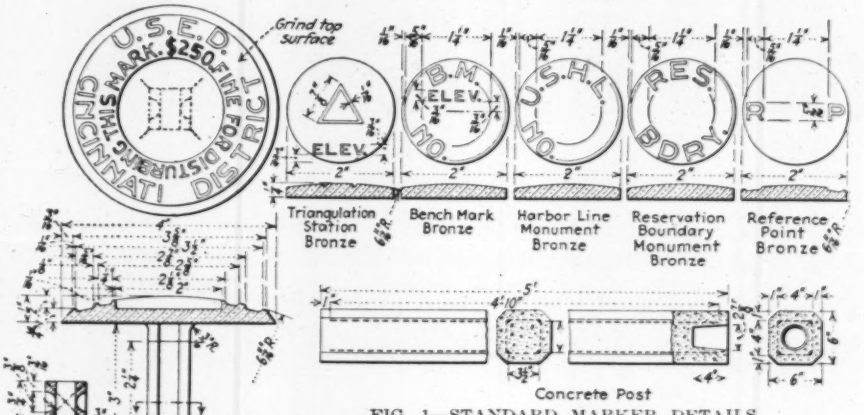


FIG. 1—STANDARD MARKER DETAILS

The marker which has been adopted, and which is illustrated by Fig. 1, is an adaptation of that used by the U. S. Coast and Geodetic Survey. This type was favored on account of its general shape and dimensions, and the method employed in placing it in the monument post. The monument post is of reinforced concrete, 5 ft. long and 6 in. square, with the corners chamfered. A recess in the top provides for the grouting in of the

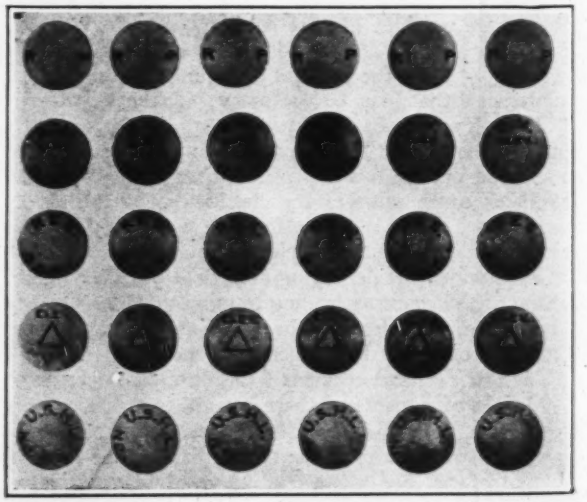


FIG. 2—THIRTY DISKS OF FIVE TYPES CAST AT ONE TIME

marker after the post is set, and is sufficiently large to allow shifting of the marker laterally 1 in. from the central position, in any direction, to take care of any error that may occur in centering the post when setting it in the ground. The marker is provided with a cored stem by means of which it is anchored into the post and, if desired, a round iron anchor pin, $\frac{3}{16}$ in. in diameter and 2½ in. long, may be used at the bottom of the stem.

It was found that four kinds of markers are necessary for use in the harbor line survey, namely, United States Harbor Line, marked "U.S.H.L. No. ——," Triangulation Station, marked with a triangle, Reference Point, marked "R.P." and Bench Mark, marked "B.M. No. ——." In addition to these, a marker for United States Reservation Boundary marked "RES.BDRY," to be used in monumenting the lines of the United States property in the Cincinnati District, has been included in the series. The acquisition of land for locks and dams, marine ways, repair yards, etc., having been practically completed in this district, and no standard having been up to this time selected for the property monuments, the opportunity to fill this need was timely.

On account of the variety of specific markings, necessary for the monuments which are to be used, there has been developed, in the interest of economy, a gang pattern from which six plates can be cast at one time, the basic or general legends, including district identification and penalty, appearing on each of the six patterns which make up the gang. A circular recess, 2 in. in diameter and ¼ in. deep, is provided in the center of each of the six patterns for the insertion of interchangeable disks bearing the specific description of the monument and forming an integral part of the pattern, the disk being held in place in the pattern by means of dowels. Six disks of each of the five kinds have been supplied, so that six complete plates bearing the same markings can be cast at one time, if desired. Fig. 2 shows the thirty disks which make up the set.

FIG. 3—FINISHED MARKER SHOWING USE OF ANCHOR PIN

Fig. 3 illustrates finished marker and use of anchor pin.

Fig. 4, showing the gang arrangement, has two patterns with center disks assembled, two patterns with center disks partly assembled, and two patterns without disks. This plate also shows the core box, partly assembled, and two of the disks, one of which is faced down to show the dowels.

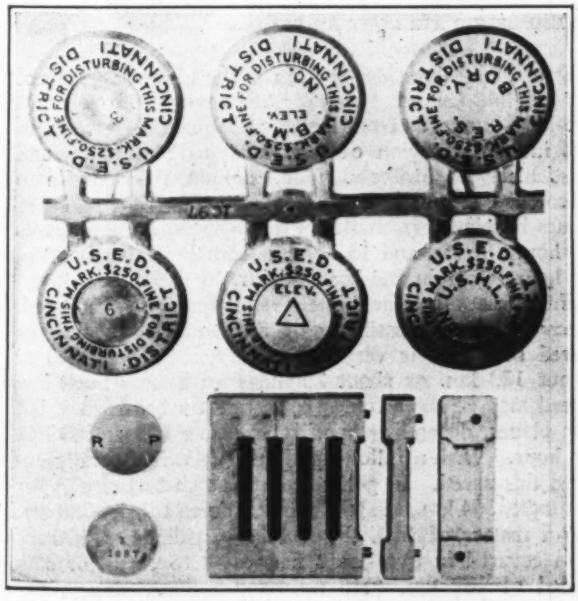


FIG. 4—GANG PATTERN FOR DISK ASSEMBLY

Motor Trucks vs. Rail Haul at Los Angeles

In the fiscal year 1923-24, 40 per cent of all general cargo and lumber passing through the port of Los Angeles was handled by motor trucks and 60 per cent moved by rail. In the fiscal year 1924-25, the percentage handled by motor trucks increased to 48, and in 1925-26 to 55 per cent. The present figures are estimated at 60 per cent by motor trucks and 40 per cent by rail but "the probability of any great additional increase in the percentage of trucking business at the port of Los Angeles seems remote," says George F. Nicholson, harbor engineer, city of Los Angeles, in a paper prepared for the convention of Pacific Coast port authorities at Vancouver, July 21-23, 1927. An analysis of individual company operations showed percentages to vary between the extreme conditions of 13 per cent truck and 87 per cent rail shipments for a company handling South American nitrates, to 96 per cent trucks and 4 per cent rail shipments for a trans-Atlantic line handling Australian cargo. However, Mr. Nicholson's paper states: "It is now thought safe to design the average terminal facility for Los Angeles harbor with the view to handling by trucks approximately 60 per cent of all foreign and intercoastal cargo, and 20 per cent of all coastwise cargo." A description of the new pier at Los Angeles, designed for a large percentage of truck traffic, was published in *Engineering News-Record*, June 23, 1927, p. 1027.

Traveling the Air
in Germany

By E. J. Mehren
Vice-President, McGraw-Hill Publishing Company, Inc.

IN AMERICA, the airplane is a factor in everyday life only as it expedites our letters. In Germany, air service is a regular daily public-service enterprise. Seventy-four routes are covered by the planes of the Deutsche Luft Hansa, while joint operation with foreign corporations extends the network far beyond German borders. Fifty cities within Germany are connected by daily airplane service, and the network has a length of over 20,000 km., or 12,000 miles.

This year the service has been extended over that of last, but over last year's network 3,800,000 plane-miles were covered, and 56,268 passengers and 2,076,000 lb. of freight, baggage and mail carried. It will be seen, then, that German air service is a well-developed enterprise, playing an important part in the business life of Germany. And be it said that the end is not yet. Big developments are doubtless ahead in German commercial aviation, within Germany and without. Her technical progress must necessarily result in her air-traffic operators and plane builders being called outside her boundaries for both machines and operation while the popularity of the service at home has grown rapidly.

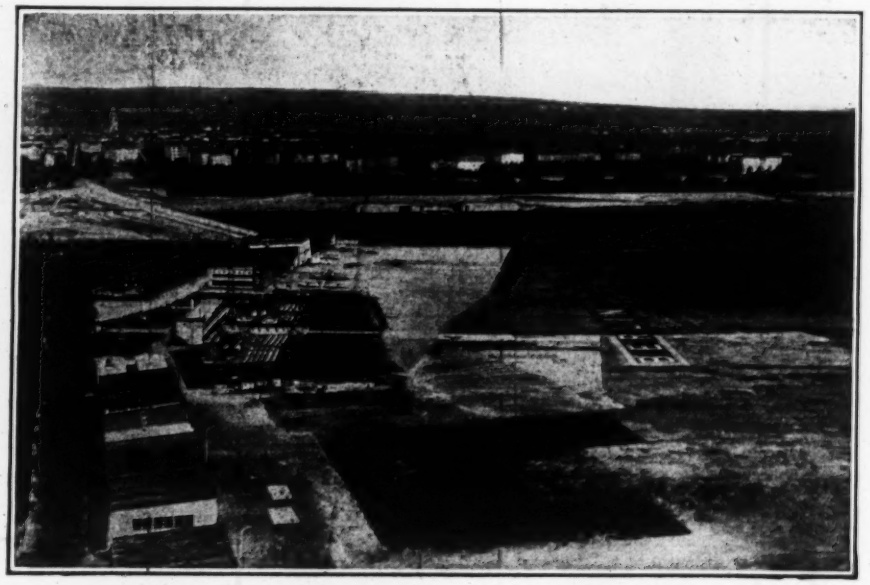


FIG. 1—TEMPLEHOF AIR PORT AT BERLIN

Flying a Business—What impresses the foreign user of that German air service is a business-like procedure of the whole thing. Buying one's first air ticket is apt to be a bit of ceremony for the buyer. Thoughts crowd on one: How safe is it? Should a plane fall, what then? Suppose there should be a bad storm?

But there is no ceremony about it for the ticket agent. For him it is a regular procedure. Further, tickets are easy to buy. You can order them from any hotel porter, or pick them up at any traveling office. When you get to the field, there likewise there is no fuss. Your ticket is taken up in a matter-of-fact way, your baggage weighed for extra charges (10 kg. go free), the bags taken to the plane and you shown to a waiting room or a veranda overlooking the flying field. In due course, announcement is made that your plane is ready. You enter without receiving any warning or cautions. In fact, there are no warnings or cautions to be given, though later one may read in the timetable that the law requires that one strap himself to the seat during starting and landing. Soon the plane is taxi-ing down the field, it turns into the wind, there is a half-muffled roar and you are in the air.

Questions of safety shortly disappear in the interest in the landscape and in the study of the map handed the passenger at the starting field, while the sight of two pilots, visible through a panel of the door between the passenger and operating compartments, gives one a sense of security. If one needs figures for further assurance, he can recall that the safety is now declared to be on a par with that of railroad or steamship travel. (Last year on the Luft Hansa lines there was one accident resulting in death.)

The flying height varies with conditions, averaging 800 meters, about 2,600 ft., on clear days. If there are heavy clouds, the pilot will stay under them and then, often, fly at a lower level. If they are light and broken he may go above them. In one such experience, in order to go over the cloud banks, the plane rose to a height of 2,400 m., or 7,800 ft.

Time Saving by Plane—Obviously, the appeal for air travel is chiefly the saving in time; though cleanliness, where a long day-ride by train is the alternative, is not a negligible factor. Naturally, the saving is greatest on the long jumps, as from Berlin to Munich, to Vienna, to the industrial region of the Ruhr, to Stockholm, and particularly to Moscow. For example, from Berlin to Munich, 317 miles, takes 11 hours by train and 4½ hours by plane; from Berlin to Moscow, 1,144 miles, is 40 hours by rail and 15 by air; from Berlin to London, 24 hours by train and boat, 9 hours by plane.

In all cases the plane time given is the *scheduled* speed. Because of the possibility of unfavorable weather the speed scheduled is very conservative. It is figured at about 120 km. or about 75 miles an hour. Such low speed may be the actual speed against a head wind, but the planes, depending upon type, fly at 150 or 180 km. an hour. With a following wind they will naturally exceed this speed. In going from Munich to Leipzig, for example, 364 km., the trip was scheduled to take 3 hours. As a matter of fact, the day being calm, the distance was covered in two hours flat, earth to earth, or at a speed of 182 km. (113 miles) per hour. The times above quoted, then, can be figured as being reduced by one-third on a quiet day, and more with a following wind.

Proper comparisons of speed by train and air require allowance to be made for the auto trip to the flying field, which is in general longer than the trip from hotel to railroad station.

For long stretches, though, the importance of air service cannot be minimized. Commenting on the international significance, one of the directors of the Deutsche Luft Hansa recently remarked that for a diplomat or

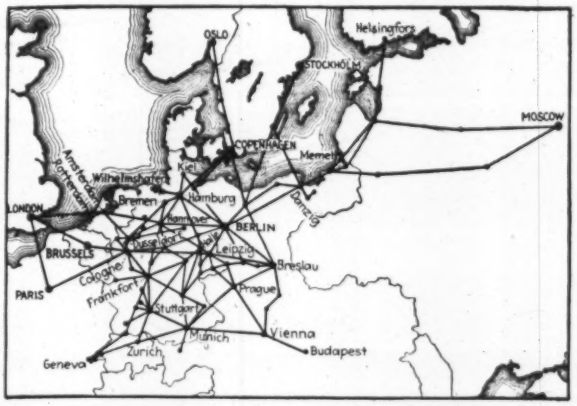


FIG. 2—MAIN AIR ROUTES IN EUROPE

business man in Berlin, Rome is now only as far away as Munich had been by train, London as far as Wilhelmshafen, Paris as far as Nuremberg.

Train Versus Plane—All flying is done by day except on the Berlin-Moscow line, on which the departure from Berlin is at 3 a.m. and from Moscow at 4 a.m. Going east a stop is made at Danzig at 6 and for breakfast at Koenigsberg at 7:20. (Later stops are made at Kovno and Smolensk.) But the subject of night flying is having very careful study, for it is realized that if this is achieved with safety and satisfaction the traffic can be rapidly increased.

For example, on journeys that can be made in one night by train, the business man is likely to go by rail, so as to have a full day for business at his destination. In using the plane he now loses half a business day. In trying to go by plane from Halle to Düsseldorf, for example, it developed that one would have to leave the business section of Halle at 10:45 a.m. and not reach the business section of Düsseldorf until 3:50 (flying time from 11:45 a.m. to 3:35 p.m.). So one goes by rail. Of course, if one had a short morning engagement in Halle and afternoon engagement in Düsseldorf, the plane would be an ideal medium.

Naturally, if night flying were general, and one could leave, say, Halle at 5 p.m. or Berlin at 4 and be in Düsseldorf at 10, it is obvious that it would be more attractive to the business man.

Undoubtedly, though, general night flying in passenger service is going to come. The needed instrument equipment for the plane is available and night lighting of routes well developed. It is a matter of cost and demand.

Fares—Airplane service in its present state of development is expensive. Depreciation is high, the personnel is high grade and highly paid, technical development requires much money for research and experiment, while the power per passenger ranges from 50 to 70 hp. (as against, say, 6 hp. in average European automobiles). Were all the charges to be paid by passenger fares and by freight and baggage income, the rates would be prohibitive. For that reason the air service of every European country is subsidized. That is the case in Germany. The central government subsidizes the international routes, the states, provinces and cities the inland routes, the total subvention amounting to something over 70 per cent of the total costs. Every plane rider in Europe, therefore, is getting more than he pays for.

By agreement with the governments the air companies charge the same, or approximately the same, as first-class railroad fares. Here are some of the fares in Germany: Berlin-Moscow, 1,114 miles, 300 marks; Berlin-Munich, 317 miles, 105 marks; Berlin-Essen, 282 miles, 85 marks; Berlin-Stockholm, 508 miles, 165 marks; Berlin-London, 615 miles, 190 marks; Berlin-Paris, 570 miles, 180 marks.

Incidentally, one asks why the governments here, national and local, are so willing to subsidize aviation. Readiness with personal and factory equipment for warfare is denied. The objective is set forth as commercial: the sale of planes to other countries and the operation of foreign air routes. Both outlets, of course, are most desirable for Germany, because both tend to increase her exports, the one visibly and the other invisibly through the sale of transport service. Further, it is pointed out that the Reich subvention is only 0.30 mark per capita as against national subventions by France and England of 4 to 5 marks. The amount of state, provincial and city subvention in Germany is not available.

Kinds of Plane—Except for a few older planes on land, flying is done exclusively with all-metal planes of German makes. The four German plane manufacturers, Junkers, Dornier, Rohrbach and Albatross, are all represented in the Hansa's equipment. Planes seating four, six or nine passengers are in use, the particular selection for a route depending on the amount of travel. Every

FIG. 3—THE JUNKERS ALL-METAL THREE-MOTOR NINE-PASSENGER PLANE

plane carries two pilots, and the planes on the longer routes are equipped with radio so that the pilots can report their positions and receive orders and weather reports. Each plane is provided with a small toilet.

Four and six-passenger planes have but one motor, but the nine-passenger planes, huge affairs built by Junkers, have three.

These big Junkers machines, known as G 24, deserve special mention. "Miss Columbia," Chamberlain's plane, standing alongside one of these all-metal giants on Templehof Field looked like a toy. The G 24 has a wing spread of 93.5 ft., is driven by three 230-hp. engines, weighs without load 8,360 lb., can carry a useful load of 4,840 lb., and fully loaded has a cruising speed of 155 km. (96 miles) per hour. Besides the nine passengers and a

crew of two, the plane can carry a large amount of baggage and freight.

New Giant Plane—This is one of the largest planes in regular service in Europe today, but since Professor Junkers has always had in mind the large development—high-capacity planes for long stretches—a still larger plane is ready for service. Two of the new type, G 31, have been built and tested, one of them on cruises to Italy and the Balkans, aggregating 7,000 km. These planes will carry 15 passengers, two pilots and a special radio operator if desired. A feature of this plane is the provision of sleeping berths, accommodating 10 people. Here are further details: a wing span of 99.4 ft., a length of 53.1 ft., a loaded weight of 16,900 lb., a speed loaded of 185 km. (115 miles) per hour, and a cruising radius of 620 miles. It has three motors totaling 1,200 hp.

Organization—All commercial aviation in Germany is, for operating purposes, in the hands of the Deutsche Luft Hansa, A. G., a 25,000,000-mark company, formed last year by the consolidation of the Junkers operating company and the Aero Lloyd. Associated companies act as agents for the Hansa, promote traffic and new routes, and handle relationships with state, provincial and city authorities and with business interests. Under this unified operation, it is expected that progress will be even more rapid than in the past. Leaders in German trade, industry, banking, transportation and government departments are represented on the directorate, so that wise

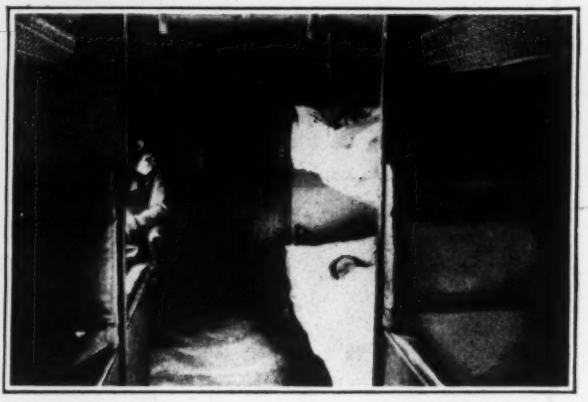


FIG. 5—CABIN OF 15-PASSENGER PLANE

and broad council is available. Last year's traffic showed an increase over that of the year before of 50 per cent in passengers, 115 per cent in freight and baggage, and 86 per cent in mail.

With Germany well served, much thought is being given to additional international routes. Already there is daily service from Berlin to London, Amsterdam, Brussels, Paris, Copenhagen, Stockholm, Memel, Moscow, Prague, Vienna, Zurich and Geneva. A route from Munich to Milan and Rome is to be opened this year, as is one to Madrid and Barcelona. In connection with the latter route a Spanish company proposes to operate a Zeppelin service to South America and the airship for this service is now being built at the Zeppelin works in Lake Constance. Dreams of routes to the Far East undoubtedly will be realized in a few years. Last year a Junkers G 24 plane flew to Peking and back. As a result of the studies made en route, it is figured that when the matter of landing fields, supplies, etc., is taken care of, the Hamburg-Shanghai route can be covered in five days with only day-time flying, while 3½ days will suffice if there is night flying as well. The Siberian railway route takes 17 days.

Difficulties—Obviously, all difficulties are not yet solved. Fog today is the chief hindrance to regularity of service, though its interference with schedules last year amounted to only 15 per cent. As far as navigating is concerned, fog is not a hindrance; the clever instruments take care of that. The trouble is in insuring a safe landing. But the problem is being worked on intensively.

FIG. 6—RADIO AND WIND-DIRECTION TOWERS, TEMPLEHOF AIR PORT

The ambition is to develop a service that can go forward under full traffic night and day, summer and winter. This will be aided in Germany by the excellent meterological reports gathered by the network of weather stations. Similar development is needed in other countries.

The Future—In closing, let it again be repeated that progress here in both traffic and plane design is very rapid. The 9-passenger, 3-motor planes were put in service only in 1925, two years ago. Now the 15-passenger, 10-berth plane is ready. Already thoughts are going farther. I saw in the Junkers factory in Dessau a dream for an ocean air liner, a full sized model with cabins built into huge wings. Six of us sat comfortably in one of the half-dozen cabins of this "dream liner." In this design the wing is enlarged and the cabins built into the wing itself. In other words, the plane would be mostly wing; at least there would be no cabin projecting above the wing or slung beneath it. They say at the Junkers works that this design is only an idea, a development for the future, but when one has seen present-day German commercial aviation, sat at a large airport and watched ships arrive and depart at frequent intervals and seen a plane for 15 passengers take the air in 16 seconds and sail gracefully off, one wonders whether the realization is so very far off. The hindrance would not seem to be technical ability but cost; the old problem of engineering—to bring costs within the range of practical economics.—DÜSSELDORF, JUNE 16, 1927.

Replacing Wood Stave Outfall Sewer with Concrete at El Paso

Wood Pipe in Bad Shape After Three Years' Use —Mastic Jointing Methods for Reinforced-Concrete Pipe Described

By Robert P. Anderson
City Engineer, El Paso, Texas

RECENT construction of a 36-in. concrete outfall sewer to replace a 36-in. wood-stave line 1,070 ft. long from the septic tanks of El Paso, Texas, to the Rio Grande required changing over the old line to the new without interruption of the sewage pumps.

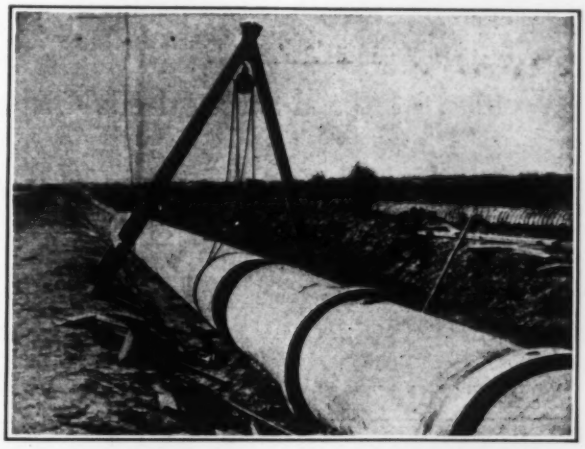
The septic tanks consist of 15 compartments which are used in succession as digestion proceeds. The maximum flow from them is 12 m.g.d., the minimum 5 and the average about 6 m.g.d. The wood-stave pipe line was built in 1922 of what is locally known as Alamogordo pine. The line was on a gentle curve through swamp about one-third of the way. Late in the fall of 1925, it became evident that this line was rapidly disintegrating and it was estimated that complete failure, due to rusting out of iron bands, to action of gases on the top part of the wood staves and to rotting on the outside of the bottom staves, would happen very soon.

The location of the new line was approximately 50 ft. east of the inlet to the old stave line and was a direct route to the river, crossing the old line at about the three-quarter point of its length. It was located in a ditch bed that had been well compacted. The line was designed to be a pressure line. Two manholes for vents were included, one at the right-angle turn, 50 ft. from the inlet chamber at the tanks, and the other 50 ft. from the river outlet at a point where the flow line started to rise to enter the outlet chamber. To facilitate construction, a pressure manhole was later included. The new line was constructed of centrifugally cast pipe in 8-ft. lengths, weighing 2,400 lb.; reinforcing 9 lb. per lin.ft., No. 8 wire circularly, No. 4 longitudinally.

The joint, at the start, was made by casting a mastic gasket made by mixing 40 parts of lime with 60 parts of asphalt. This was placed on the end of the pipe already laid. The new length of pipe was then placed against the gasket and pressure of twenty tons applied by means of a jack until the mastic was forced out between the joints. It was so difficult to obtain the requisite pressure all along the line, on account of yielding earth, that a better method was adopted.

In this second method, the joints of pipe were first laid to grade and line with a ½-in. space between the ends of the pipe. A band with expansion bolts was then placed on the inside and another clamped on the outside, with a vent at the top. The hot mastic was then poured into the joint and allowed to cool for a few seconds. Then, by means of a jack butted against the line of eight lengths of pipe laid in ditch ahead, sufficient pressure was brought on the newly laid joints to force them together, eliminating all possible voids and reducing the thickness of the joint from ½ to ⅜ in. A centrifugally cast collar, 5 in. wide, was then slipped on the joint and blocked up and four strands of dry jute calked in directly over the joint. This was then backed up with a 1:1 cement grout. Experiments showed that with a range of temperature from 32 to 70 deg. the uncollared joint would show a separation of mastic from pipe, due to contraction, every fifth joint. In other words, the adhesive strength of the mastic joint was equal to the frictional resistance of six tons of pipe on the damp earth, bearing surface being 40 sq.ft. On account of this range of temperature, the pipe was covered as soon as possible after the joint was made with at least 12 in. of dirt. No separation of joints was noted on inspection inside.

The pipe was laid on the ground to a point 300 ft. from the river where quicksand was encountered and cradles of railroad ties were placed to hold the pipe in position while being jointed.



LAYING 36-IN. CENTRIFUGALLY CAST REINFORCED-CONCRETE PIPE, EL PASO, TEXAS

As a further prevention against possible gas and acid action on the inside of the concrete pipe a $\frac{1}{16}$-in. mastic coating was placed after the pipe was thoroughly cured.

The main difficulty encountered was in crossing the old line, at which point the flow line of the new and old conduits were nearly the same. The crossing was made at an angle of about 15 deg. At first it was thought that the old line could be flumed over, but inspection showed that the disintegration of the wood staves had progressed to such a degree that it was impossible to disturb the pipe in any way with any temporary construction. A pressure manhole was then built on the far side of the old line and the laying of pipe continued to the river and completed, except that four lengths of pipe were left out at the crossing to be placed on the night of cutting into the new line.

The change over was accomplished on Saturday night and Sunday morning, when the sewage flow is lowest. Previously the septic tanks had been emptied with exception of two of the 15 digesting chambers which were half full. At midnight the flow into the old line was shut off and turned into the empty tanks. The old line was cut and cleared away and the new line laid by 10:30 a.m. By 12 o'clock the pressure manhole had been sealed and was ready for taking the flow. A ponding area that had been provided proved to be a wise precaution as it was necessary to pass about 0.28 m.g. into this area. As soon as work on the line was completed the flow was shut off from the ponding area and diverted into the reserve tanks. Then a precast slab was placed and bolted in the old outlet from the chlorinating chamber in 90 min. and at 2 p.m. the flow was again directed to the

chlorinating chamber from which it passed into the new outlet constructed on the side of the chamber and into the new line. Fifteen minutes later the line was filled and the sewage was again emptying into the river.

The old line, laid with a rise of 2.2 ft. in 1.070 ft. from the inlet to the outlet, after a few years' continuous flow showed an accumulation of about 3 in. of sediment on its bottom. Some staves in the old line showed little or no disintegration while others next to them were practically destroyed by gas filtration and when dried out crumbled in the hand. Staves from the bottom of this line, lying only a few inches above the seepage water line in this low land, were continually in damp soil impregnated with alkaline salts.

The iron hoops appeared to have failed in all cases where gas was escaping through disintegrated pipe.

Welded Material Strengthens Old Railway Truss Bridge

Missouri River Spans of Chicago Great Western Ry. Reinforced by New Plates—Cheaper and Quicker than Riveting

By W. R. Roof
Bridge Engineer, Chicago Great Western Ry.

STRENGTHENING a large railway truss bridge and draw-span with additional material applied by welding instead of riveting has been carried out recently on the Chicago Great Western Ry. Welded reinforcement was applied to the chords, floorbeams and stringers. Other reinforcement, which did not involve welding, included the lateral system of the stringers and some of the truss hangers and counters.

This bridge, Fig. 1, crossing the Missouri River at Leavenworth, Kan., consists of two 330-ft. pin-connected fixed spans and a 440-ft. swing span, all with single track and designed for a live-load of 3,000 lb. per lin.ft., no locomotive load being specified. It was designed by the late George S. Morison, and built in 1893 for the Leavenworth Terminal Ry. & Bridge Co., which is now a subsidiary of the Chicago Great Western Ry. Steel was used for the chords, end posts, eyebars and pins, while all other parts were of wrought iron. The material was found in good condition, little affected by rust or wear. The substructure was built by the Missouri Valley Bridge Co., Leavenworth, and the superstructure by the Union Bridge Co., now a part of the American Bridge Co. The deck is planked, so that the bridge carries both highway and railway traffic.

To handle the heavy and increasing freight traffic of the railroad it was desirable to introduce more powerful locomotives, but on this part of the line the Missouri River bridge made it necessary to restrict the engines to axle loads of less than 49,000 lb. and double-heading was not permissible. It was proposed, therefore, to strengthen the superstructure of the bridge to carry a locomotive of the G-3 class (2:8:0) with 50,550-lb. axle loads or the L-3 class (2:8:2) with 55,000-lb. axle loads, followed by a uniform train load of 4,000 lb. per foot of track. No double heading is allowed. This is a heavy loading compared with the original of only 3,000 lb. per foot. It was thought at first that the necessary additional plates would be applied by riveting, which would have required about 45,000 rivets, but the American Bridge Co. presented an alternative bid for use of the arc-welding process. This bid was lower than any of those for riveting, while the work could be done more easily and with two months' saving in time.

In the fixed spans, the top chords were reinforced by plates ½x20 in., applied on the top cover plates, the width being such as to fit between the lines of rivets, and the length fitting between the lateral plates at panel points. Continuous welds were made at the ends and sides of the new plates, supplemented with stitch or spot welding along the center line through $\frac{13}{16}$-in. reamed holes spaced 12 in. c. to c. The bead of the welding, ¼ in. wide, was fused deeply into the original plate and the new plate, and after the central spot welding the holes were filled with the welding metal.

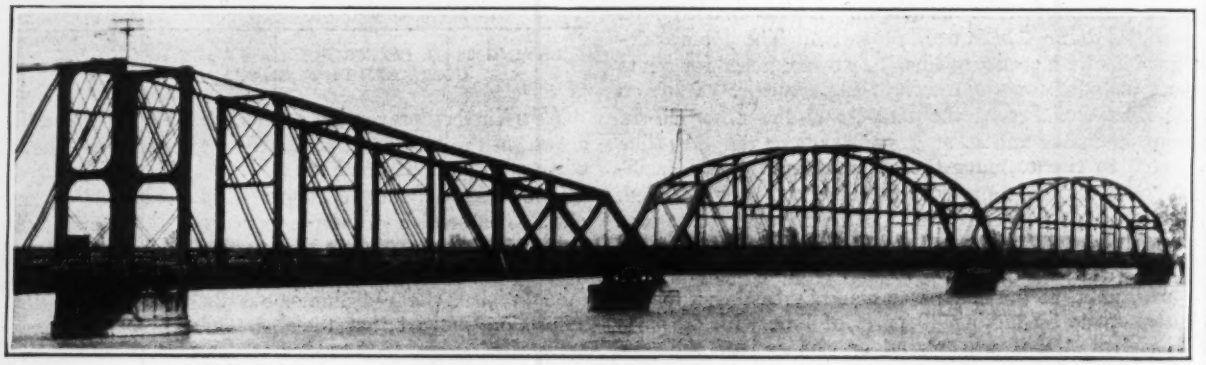


FIG. 1—LEAVENWORTH BRIDGE; CHICAGO GREAT WESTERN RY.
All spans reinforced with welded material.

All floorbeams were reinforced with cover plates 12

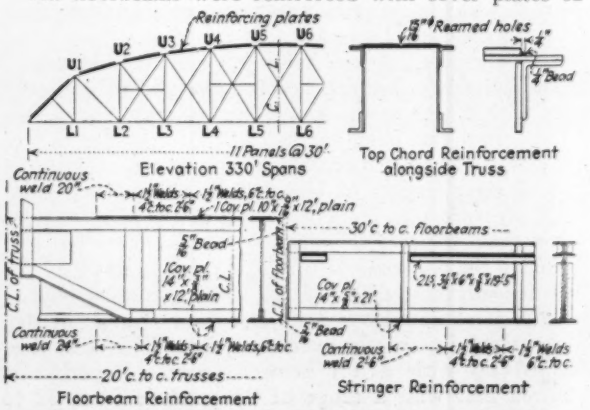


FIG. 2—REINFORCEMENT OF BRIDGE BY WELDING

ft. long, welded to the top and bottom flange angles. The top cover plate, 10x$\frac{9}{16}$ in., was made narrower than the flange so as to leave room for the welding bead on top of the original angles. The bottom cover plate, 14x$\frac{3}{8}$ in., was made wider than the flange so that the bead could be made along the toes of the angles. Continuous welds were made for 20 and 24 in. at the ends of these plates, the remainder of the length having 1½-in. stitch or spot welds at intervals of 4 to 6 in. along the sides, as shown. For the stringers, cover plates 14x$\frac{5}{8}$ in. and 21 ft. long were welded over the bottom flange angles. The general arrangement is shown in Fig. 2,

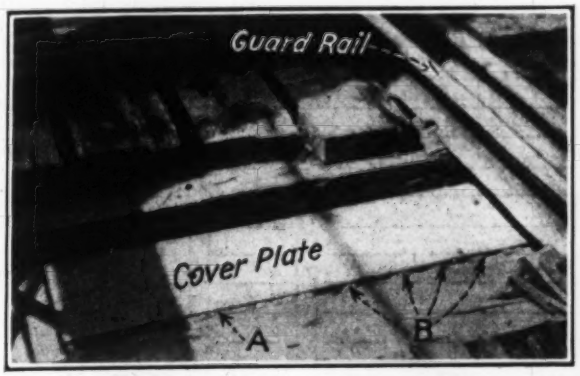


FIG. 3—REINFORCED FLOORBEAM

Note continuous weld, *A*, at end of top cover plate, and intermediate spot welds, *B*.

while Figs. 3 and 4 show the welded cover plates. To avoid removal of the deck, which would have been necessary for welding cover plates on the top flanges of the stringers, these flanges were reinforced by riveting a second pair of flange angles to the web, just below the original flanges, after cutting short sections out of the stiffeners to clear the new angles. In the swing span only the floorbeams and stringers needed reinforcement.

In field tests of the welding, failure occurred always in the original plate or the new plate, but never in the weld. The specifications for the welding material called for a tensile strength of 50,000 to 60,000 lb. per sq.in. In all, about 7,500 lin.ft. of weld was made, using 1,950 lb. of a special welding steel.

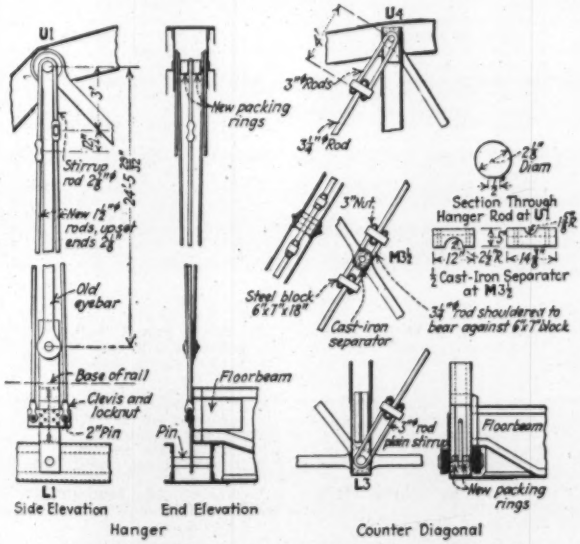


FIG. 5—REINFORCEMENT OF WEB MEMBERS

For the web members of the fixed spans, the hangers of the first panel (U1-L1) and the counter diagonals of the fourth panel (L3-U4) were reinforced by rods, as shown in Fig. 5. For the hanger, two rods were attached by turnbuckles to a stirrup looped over the top-chord pin, while their lower ends were attached by clevises to a plate riveted across the end of the floor-beam. Each counter diagonal consisted of a single rod with ends attached to stirrups passing over the chord pins and with a double rod connection at mid-height to clear the pin in the main diagonal, as shown. The hanger stirrups were bored to give a ½-in. flat bearing on the 7-in. chord pins, and the counter stirrups for a similar ¾-in. bearing. The original stringers in the fixed spans had diagonal rod bracing. As this interfered with the new top flange angles it was removed and replaced with steel angle bracing which stiffened the floor system. Rivet holes for the connection plates of the new lateral

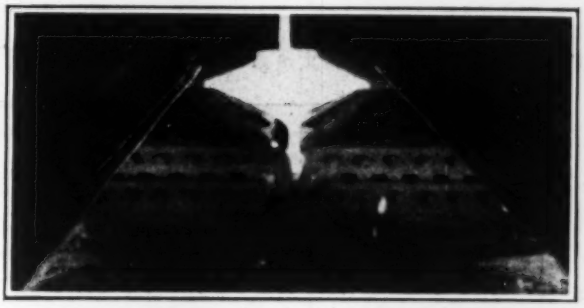


Fig. 4—WELDED REINFORCEMENT OF END FLOORBEAM

Lines below bottom flange angles indicate new cover plates welded in place.

bracing were drilled after the new bottom cover plates had been welded in place.

The weight of new structural steel was about 112 tons, as follows: Cover plates, welded in place, 104,340 lb.; flange angles, riveted, 82,738 lb.; loop rods, 24,275 lb.; miscellaneous 13,443 lb.; total 224,786 lb. In addition, there was 1,950 lb. of welding steel. Work was begun Feb. 25 and was completed April 28, with an average force of twenty men. Railway traffic was not interrupted, but highway traffic was suspended temporarily. Four arc-welding machines were used, two supplied by the Electric Arc Cutting & Welding Co. and two by the Westinghouse Electric & Mfg. Co. Power available at the bridge was 60-cycle, 3-phase, 220-volt current, and the work required about 4,500 kw.-hr. For the American Bridge Co., the work was in charge of H. C. Hunter, assistant engineer, and Otto Shultz, foreman. For the Chicago Great Western Ry., it was under the direction of C. G. Delo, chief engineer, and the writer.

Incomes from Rail and Water Transportation

Corporations engaged in rail transportation had gross incomes aggregating $6,564,312,236 in 1925, it is shown by figures just made public by the Bureau of Internal Revenue. Returns were made by 1,749 companies, of which 840 incurred deficits totaling $64,788,317. The net income of the other 909 amounted to $735,470,260. The gross incomes of the 1,748 companies engaged in water transportation aggregated $323,840,771. The net incomes of 956 of those corporations amounted to $40,-161,316, while 792 of them had no net incomes, but instead had deficits of $19,370,744.

Third Article of a Series on
HIGHWAY MAINTENANCE

Road Maintenance by Contract

By G. F. Schlesinger
Director, Department of Highways and Public Works, Ohio, Columbus

THE MEANING of the term highway maintenance is not fixed and the exact operations included may vary with different highway organizations. Maintenance, in the dictionary sense, means to preserve something in its original condition. In many states, all forms of routine repairs, resurfacing, reconstruction, including widening and minor grade and alignment changes, are classified as maintenance—frequently in order that they may be eligible to receive a certain class of appropriated funds. In private industry, such as a railroad company, it is important that any expenditure for reconstruction that is greater than that required to "renew in kind" be classified as an addition and betterment and a strict accounting made of it. The company is thereby enabled to capitalize this account and increase its credit and borrowing powers. While most highway departments make attempts to distinguish between betterments and routine maintenance, there is not the incentive in the way of financial advantage for a rigid classification. In this discussion of highway maintenance that is adaptable to the contract method, maintenance will be considered in a broad sense as including all work necessary to make an existing highway economical, safe and convenient for travel. In this sense, such service as the erection of warning signs, route markers, the maintenance of detours, the removal of snow, etc., are logically part of the functions of a maintenance organization.

Many Maintenance Operations—There is a considerable variety of operations involved in the maintenance of a modern highway. The quantity and kind of maintenance necessary to apply to a road will vary greatly with conditions. The surfacing may consist of anything from native earth to the highest type of pavement. The quantity and nature of the traffic have effect not only on the amount but also on the standard of maintenance. Difference in topographic, geologic, and climatic conditions is reflected in the kind of treatment it is necessary to give the road. Following is a list of maintenance operations taken from the record of the Ohio Division of Highways:

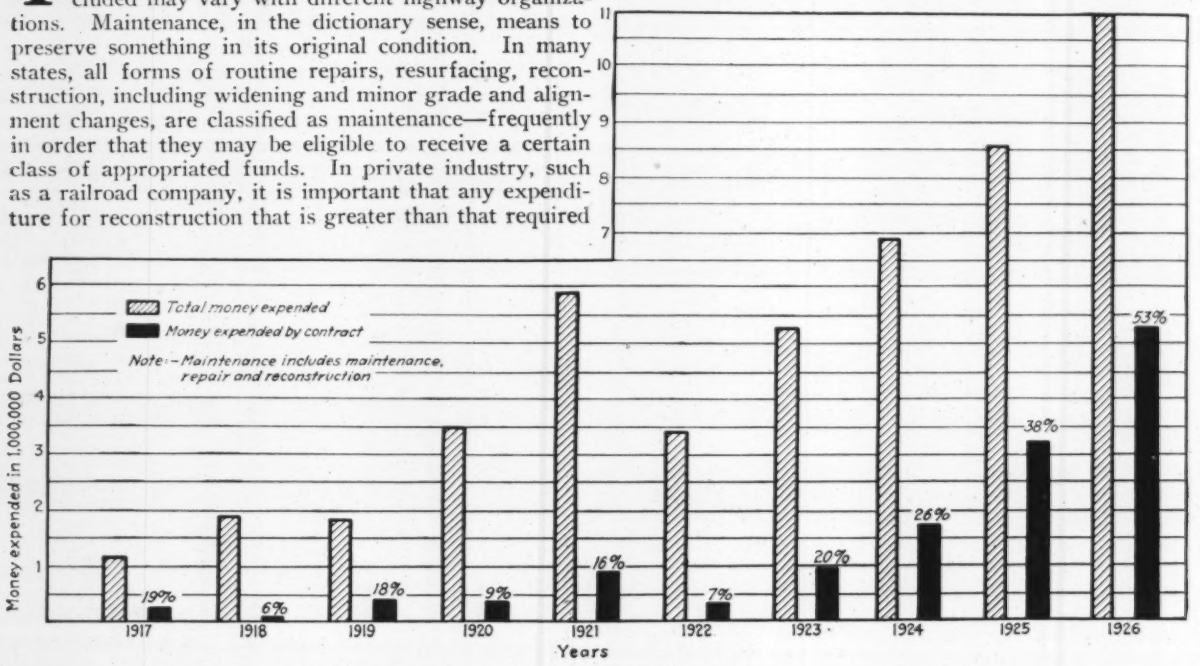


FIG. 1—ANNUAL EXPENDITURE FOR CONTRACT MAINTENANCE OF STATE ROADS IN OHIO

SURFACE

- Bituminous surface treatment
- Screening surface
- Bituminous paint patching
- Bituminous wave patching
- Mixing bituminous patch materials
- Taking out crown
- Sealing edges
- Widening curves
- Superelevating curves
- Widening surface
- Resurfacing
- Repairing pavement failures
- Sealing cracks
- Refilling surface (brick)
- Transporting materials
- Removing snow
- Cindering slippery surface
- Maintaining detours
- Dragging surface (traffic-bound roads)
- Applying metal to surface (traffic-bound roads)
- Applying dust palliatives (traffic-bound roads)
- Metaling side roads (on one-lane pavements)
- Building turnouts (on one-lane pavements)
- Quarrying and crushing materials

ROADBED

- Increasing sight distance
- Widening roadbed
- Scalping shoulders
- Metaling ruts
- Metaling shoulders
- Building up shoulders
- Seeding shoulders
- Opening ditches
- Opening drains
- Dressing slopes
- Removing slips
- Constructing drains (tile or blind)
- Repairing guard rail
- Painting guard rail and poles (including cold water paint and whitewash)
- Erecting guard rail
- Mowing weeds and brush
- Grading roadbed
- Dragging shoulders
- Dragging side roads
- Metaling side road approaches
- Repairing side road drains
- Riprapping
- Cribbing

MISCELLANEOUS

Repairing washouts	Investigating accidents
Repairing bridge floors	Trapping ground water
Repairing drainage structures	Paving gutters
Repairing signs and markers	Building breakwaters in streams
Erecting signs and markers	Building breakwaters on slopes
Making signs and markers	Constructing temporary bridges
Painting center lines and pavement marking	Repairing and overhauling equipment
Painting bridges	Erecting garages and equipment storage buildings
Building small retaining walls	Repairing buildings
Piledriving	
Stream relocation	

Limitations and Advantages of Contract Work—In the early years of the present era of the development of highway transportation, new construction was the dominating activity. Maintenance was of very minor importance because the newly constructed "permanent" roads required very little attention. The small repairs necessary were of the class that could best be done by

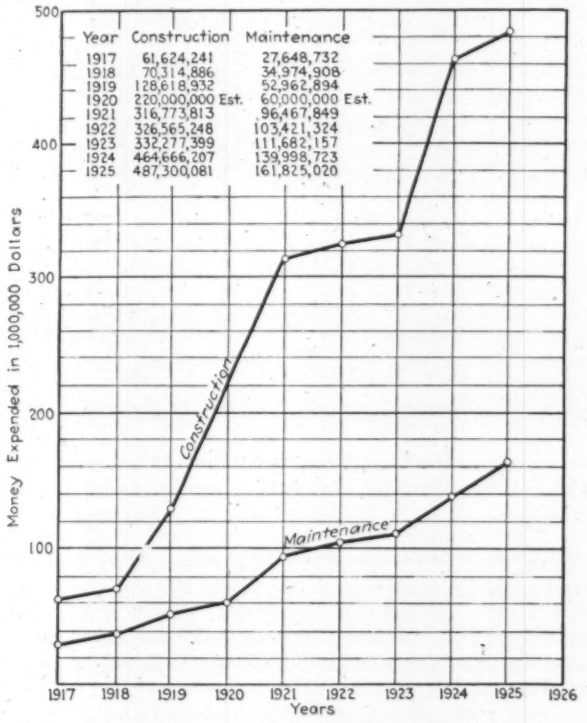


FIG. 2—ANNUAL EXPENDITURES BY STATE HIGHWAY DEPARTMENTS

direct labor employed by the highway authorities. There was no maintenance work of the magnitude that would prompt any thought of the contract system. One of the principal subjects of discussion at that time was the relative merits of the patrol or gang systems for making repairs with direct labor. In a few years, the unforeseen development in motor vehicular traffic began to cause the destruction of road surfaces and create maintenance and repair problems of a magnitude never dreamed of in the beginning. It was natural that highway departments should expand existing direct labor forces in order to handle the larger repair projects such as the reconstruction and widening of highways. It has become, perhaps, second nature to consider any operation, classified as maintenance, as one to be performed by direct labor, regardless of its size or character.

The writer favors the general principle that the private contract system is preferable to day labor methods on public work. A democratic form of government such as that of the United States does not call for the supplanting of private enterprise with governmental agencies. In fact, the greatness and prosperity of our country has rested largely upon the encouragement of private industry in all lines of endeavor. There is no reason why the highway construction industry should be an exception. Most highway officials are convinced

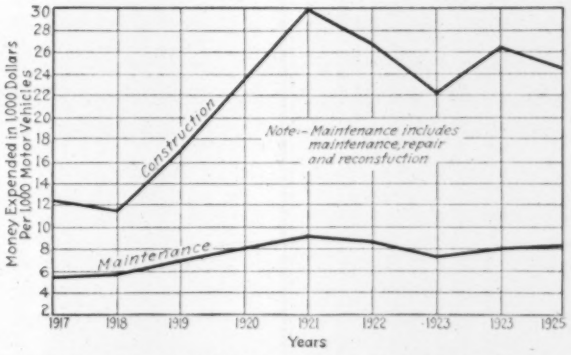


FIG. 3—ANNUAL EXPENDITURES ON STATE ROADS PER 1,000 MOTOR VEHICLES
Maintenance includes repairs and reconstruction.

from their own experiences that the performance of highway projects by direct labor methods is not as economical as by contract. Centralized control of state highway operations is necessary, but the maintenance of a large personnel and the investment of funds in road equipment for work that can be done by contract should be avoided wherever possible.

However, a reference to the maintenace and repair operations listed above will show that in many cases it would not be feasible to let them by contract. The principal objection to the contract method is based on the impracticability of formulating definite plans in advance

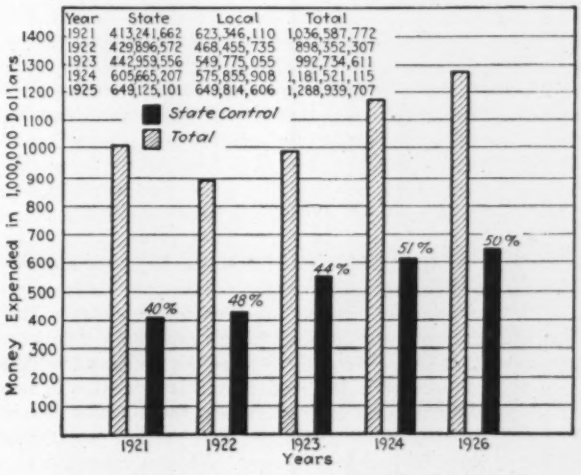


FIG. 4—STATE VS. STATE AND LOCAL HIGHWAY EXPENDITURES

of the work. This is necessary as a matter of fairness to the bidders, to enable the awarding authority to secure a proper comparison of the bidders, and to avoid the evil of over-run and unbalanced items. While it is true that this objection applies minor operations, in the aggregate they form a large part of the total maintenance cost.

TABLE I—DISTRIBUTION OF MAINTENANCE EXPENSES IN OHIO BY CONTRACT
Figures show money expended on contracts and net amount of contracts let during year.

Item	1921	1922	1923	1924	1925	1926
Resurfacing	$868,645	$187,984	$764,080	$1,052,289	$844,151	$1,521,005
Widening	38,702	.....	28,906	381,839	181,557	211,692
Furnishing and spreading traffic-bound top	.....	.....	.....	17,468	2,041,232	3,000,000
Reconstructing bridges	12,838	5,856	70,029	255,534	109,932	210,176
Widening bridges	.....	.....	.....	.....	.....	4,136
Painting bridges	.....	.....	.....	.....	5,159	17,755
Reconstructing culverts	.....	.....	987	.....	.....	30,954
Surface treating	29,528	345	.....	46,164	.....	114,329
Grading	.....	.....	8,214	1,833	22,907	69,504
Curb	.....	.....	45,615	32,195	2,769	29,539
Retaining walls	5,656	4,347	.....	.....	.....	1,700
Furnishing and erecting guard rail	.....	.....	.....	.....	.....	13,112
Constructing division garages	.....	.....	.....	.....	.....	100,000
Repairing bridges	2,496	7,527	.....	.....	.....	.....
Total	$957,865	$206,059	$917,831	$1,787,322	$3,211,707	$5,323,902

Among other disadvantages and limitations to performing highway maintenance by contract the following are often advanced and will be discussed in order.

(1) For certain types of maintenance work the contract system is not sufficiently flexible. Two outstanding examples are snow removal and the maintenance of detours. These operations constitute a very essential service to the traveling public and should not be delegated by contract to agencies other than employees of the highway department. Requiring the contractor to maintain detours as a part of his contract has been tried and found

FIG. 5—PATCHING BROKEN-UP CONCRETE ROAD

decidedly unsatisfactory. The amount and location of snow removal in most states are such variables that the degree of flexibility in forces and equipment necessary precludes the contracting of this work. Certain kinds of repair work such as small patching, sealing cracks, constructing small culverts, cleaning ditches, etc., can be much more opportunely prosecuted by direct labor. Traffic-bound sand-clay, gravel, or stone roads, maintained by dragging, require the most timely attention. This work will vary greatly with weather conditions. Its general attenuated nature also makes it undesirable to contract from the standpoint of both the highway authorities and the contractors.

(2) The contract system involves undue delay. Before bids are received on public work contracts, a certain amount of red-tape procedure must be followed which consumes time. It is believed that this criticism is not valid, as with a good budget system most maintenance work that is susceptible to the contract system can be anticipated and planned in advance. When it comes to the purchase of equipment and materials necessary to pursue the work, the contractor has the advantage from the standpoint of expediting matters, as the same delay due to red-tape is involved in their purchase by public authorities as in letting contracts. However, there are emergency conditions of comparatively infrequent occurrence that do not permit delay. Landslides and slips, floods, wash-outs, and sudden pavement failures are in this class.

(3) An inferior quality of work is obtained by contract. There are undoubtedly some grounds for this charge as applied to the class of contracts that are not of sufficient size to attract competent contracting organizations. For example, contract work on traffic-bound maintenance consisting of small contracts frequently located in isolated territory is often bid in by local contractors of a decidedly "small-fry" caliber. It may be a just criticism in the case of much maintenance work that requires great care and specialized effort—such as bituminous patching and surface treatment (especially an initial application). It is believed, however, that with time and patience a clientele of contractors qualified to perform so-called specialized maintenance work can be established. With the increase in volume of such work, the contractor's organization can with experience acquire the required skill. Exercise of intelligence by highway officials in the selection of "qualified bidders," and strict and impartial inspection, will aid materially in producing the desired results.

On reconstruction work of a larger magnitude, the question as to which system—contract or direct labor—will produce the better quality of work is indeed debatable. It may be argued that there is no financial advantage to the state in "skinning the job" when performed by direct labor. On the other hand, to permit a contractor to violate requirements of specifications is a reflection on the engineering supervision and inspection and not a valid criticism of the system. How often have contractors and highway engineers alike observed practices in direct labor operations that would not be tolerated on a contract job? The former is usually carried on under the direct control of non-technical superintendents without the degree of engineering inspection that obtains on a contract. Non-conformity with the provisions of the specifications is not taken as serious. The element of mental vigilance that exists in both the inspector and contractor is missing.

(4) Contract work is less economical. Such a conclusion is predicated on the theory that in a direct labor operation the contractor's profit and cost of inspection is saved. This gain is more theoretical than real, being counterbalanced by other factors that increase the expense of direct-labor work. Little reliance can be placed on figures that have been issued by highway departments on the cost of direct-labor projects, unless they are substantiated by a thorough investigation to determine whether all items—direct or indirect—that enter into the cost have been included. It is one of the fundamental qualities of human nature that a man will give more careful attention to work from which he derives a financial benefit by being efficient, than to work in which his salary is not directly affected by any results produced

short of complete failure. This principle is recognized by industry which in many cases is giving employees a financial interest in the business. The psychology of the situation is detrimental to the economical performance of public work by direct labor. Many workmen, material and equipment companies, citizens who sell right-of-way and claim damages, and people in general, consider government a legitimate prey and govern their actions accordingly. In this statement of fact no reflection is intended on the many faithful and conscientious employees in public service.

FIG. 6—MOWING WEEDS ON SHOULDERS AND DITCHES

It is true that where experienced contractors have not been developed to perform specialized maintenance work, direct labor may at first be more economical than by contract. Competition is limited, and those who compete bid high because they are unfamiliar with the work. However, in the long run, after qualified contractors are developed, the initial disadvantage will be more than offset by the subsequent gain. It has been only a few years since highway contracting on new construction was an infant industry, and a similar situation was experienced.

Contract Practice in Ohio—The Ohio Division of Highways, believing it desirable to perform maintenance work by contract when feasible, has for several years made a consistent effort to practice this policy. Fig. 1 shows that from 1917 to 1923 the percentage of the total expenditures for maintenance by contract varied from a minimum of 6 to a maximum of 20. Since 1923 it has increased at a fairly uniform rate to a maximum of 53 per cent in 1926. In Ohio the law for several years has provided that all highway work, both maintenance and construction, estimated to cost more than $3,000 per mile, must be done by contract. The highway department recommended a limit of $5,000, but this was reduced by the law makers. The wisdom of any such legal restriction can be questioned on several grounds. It may be maintained that the highway department executives should not have their freedom of judgment and action hampered by such restriction. A condition might arise where fair and open competition does not exist and such a law takes away from the administrative official a means of correction. The legislature, however, evidently discounted the objections. It recognized that the enforcement of the principle that highway improvement by contract is to the best public interest might be endangered by the whims of the individuals who determine the policy of the highway department. While the present highway department would prefer that the limits be raised to $5,000, with provisions for an increased amount for emergency work, the law has in general been satisfactory in its operations. Nor does this law by any means account entirely for the increased proportion of maintenance by contract in Ohio. At least half of the work let by contract in 1926 was not affected by the law in question.

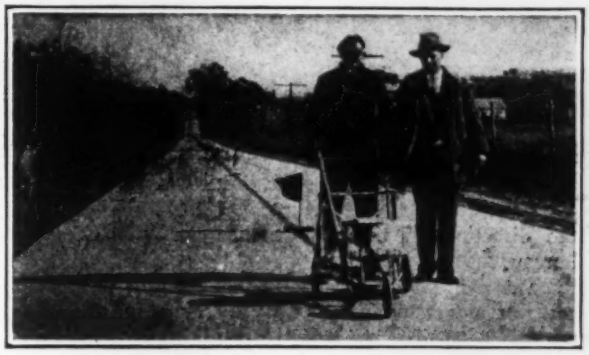


FIG. 7—MARKING CENTER TRAFFIC LINE

TABLE II—BIDS ON 52,750 LINEAR FEET OF GUARD RAIL IN OHIO

Bidders	46,500 Lin.Ft. Type D Per Ft.	3,550 Lin.Ft. Type E Per Ft.	2,700 Lin.Ft. Type C Per Ft.	Total	Certified Check
Thompson Pav. Const. Co.	$0.48			$22,320.00	$1,500.00
		$0.46		1,633.00	
			$0.40	1,080.00	
Central Const. Co.	.45			20,925.00	1,200.00
		.44		1,562.00	
			.43½	1,174.50	
Van Wagner Const. Co.	.41½			19,297.50	1,500.00
		.38		1,349.00	
			.35	945.00	
Newell & Smith	.50			23,250.00	1,300.00
		.47		1,574.50	
				1,668.50	
			.45	1,215.00	
Ideal Const. Co.	.49			22,785.00	1,600.00
		.49		1,739.50	
			.49	1,323.00	
Smith Bros. Hdwe. Co.	.55			25,575.00	1,450.62
		.46		1,633.00	
			.53	1,431.00	
Highway Guard Const. Co.	.47			21,855.00	1,250.00
		.47		1,668.50	
			.44	1,188.00	
N. B. Putman Co.	.58			26,970.00	1,533.30
		.60		2,130.00	
			.58	1,566.00	
The Phil Garrigan & Son Co.	.52			24,180.00	1,390.32
		.55		1,952.50	
			.62	1,674.00	
Henry W. Bergman	1.00			46,500.00	2,601.15
		1.00		3,500.00	
			.75	2,025.00	

The classification of maintenance expenditures by contract in Ohio since 1921 is shown in Table I. The variety of operations has increased with the total amounts and proportions let by contract. It is believed that for certain items such as bituminous surface treating, erecting guard rail, and the maintenance of steel bridges, the amount done by contract in the future will be increased. Regarding the repair and painting of steel bridges, following is the opinion of J. R. Burkey, chief engineer of bridges of the Ohio Division of Highways.

"The maintenance and repair of steel bridges is a specialty involving certain operations, in many cases, which our maintenance forces are not equipped to perform. For instance, when we renew or repair the floor of an old structure, it is our policy to take advantage of the lightened condition of the structure, to jack up the bridge, clean out the rollers, and, in many cases, renew them since they are generally the worst corroded portion of the structure. Frequently, connections are so badly

rusted that they need replacing. Any new steelwork that is required in connection with this work generally requires shop work, and measurements taken for this shop work necessarily must be precise since the responsibility for the final fit depends upon these measurements. For this reason it is desirable to contract this work, in which case our specifications require that the contractor will be responsible for any detail measurements involved in the fitting of new work with old.

"The matter of tightening up steel bridges requires a special experience which the state cannot afford to hold in readiness for such occasional work. This, again, should be done by structural bridge contractors under the direction of the maintenance engineer or bridge bureau.

"The painting of large steel bridges can be done by contract as economically as by maintenance, and to my mind it is questionable whether it cannot be done better. In many cases it requires special equipment together with experience in handling this equipment, on account of the hazards that are involved."

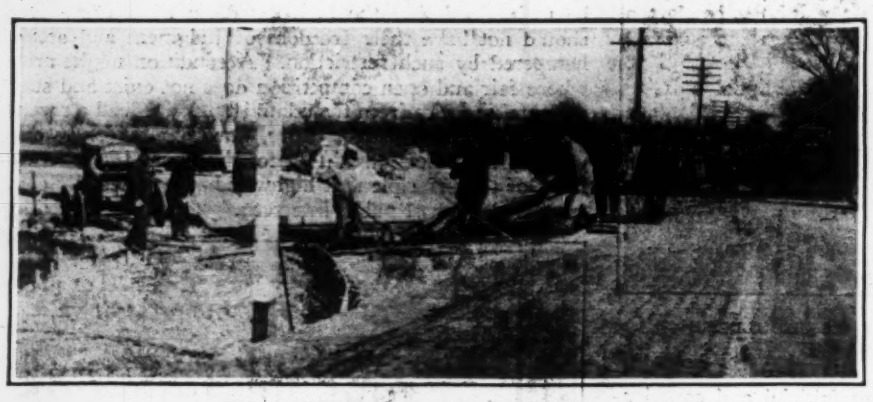


FIG. 8—WIDENING A PAVED CURVE

In 1924 the Ohio Department of Highways decided to embark on the policy of maintaining the unpaved sections of the state highway system. This accounts for the relatively large expenditures in the last three years for traffic-bound maintenance, practically all of which was performed at first with direct labor. Placing over 2,000 miles of traffic-bound roads under maintenance in three years could not have been accomplished unless a large portion of the work had been contracted. At first it was difficult to secure competent bidders, due to the jobs being so small in amount and the work unfamiliar to Ohio contractors. At present there exists a fairly satisfactory corps of qualified bidders, although there is still room for improvement.

All projects of any magnitude are let using the same procedure as in new construction contracts, including advertising, bidder's certified check, and surety bond. Bidders are required to submit standard experience questionnaires and financial statements recommended by the Joint Conference on Construction Practices, to assist in the determination of the "lowest and best" bidder. In 1926, 71 per cent of the maintenance contracts were awarded in this manner. Smaller contracts are let more informally on departmental orders, although an effort is always made to secure full competition from bidders who are in a position to properly handle the work. On many small projects the contractors have not been required to furnish a surety bond, but the department has found this policy unsatisfactory and will require a bond on practically all contract work in the future. All contracts are on the unit-price basis.

A tabulation of bids received for a type of work that until 1926 was all done by direct labor may be of interest. Proposals were received in October, 1926, for "furnishing all material and labor necessary for the erection of 52,750 lin.ft. new guard rail in place complete —51 openings," (Table II). The successful bidder was the Van Wagner Construction Co. of Bowling Green, Ohio, and the work is progressing satisfactorily. The tabulation shows that there was ample competition with a material variation in the bid prices submitted.

The annual expenditures for maintenance and construction of all state highway departments of the United States are shown graphically and by figures in Fig. 2. These expenditures in dollars per thousand motor vehicles registered are indicated by Fig. 3. Fig. 4 shows that the annual highway expenditures under state control are about 50 per cent of the total rural highway expenditure by all political units. In a previous discussion ("Resurfacing and Maintenance Work as a Future Field for the Contractor"—1926 Convention *Proceedings* of the American Road Builders' Association, p. 240), the writer has estimated that the total expenditures for maintenance and resurfacing in the United States for the next five years will be about $1,600,000,000. It is the belief of many students of the problem that a considerable saving in these expenditures can be effected by the use of the contract system when feasible. It is the duty of highway authorities to give thorough consideration to this method of handling future highway maintenance work to effect all possible saving.

FIG. 9—BITUMINOUS SURFACE TREATING

It may be expected that the new construction curve on Fig. 2 will at some time in the future assume a downward trend. It will undoubtedly be many years before the peak is reached, considering that less than one-fifth of the total mileage of rural highways in the country have had some type of surfacing. It is reasonable to assume that the maintenance curve will have an upward trend for an indefinite time. The statement frequently

made that eventually all highway expenditures will be for maintenance is at least theoretically true. However, the expenditures for maintenance will never assume the relative proportions that they have for construction.

Pavement failures will not be as frequent nor extensive in the future. This opinion is based on the following:

(1) There will be no great or sudden increase in concentrated traffic loads such as occurred when the motor truck came into general use. This is precluded by legal weight restrictions in the statutes of all states and more effective enforcement of traffic laws. In other words, the character of highway traffic so far as wheel loads are concerned has reached a point of stabilization.

(2) Rational design methods and improved construction practices have been developed as a result of past experience and highway research. This applies to both new construction and reconstruction.

(3) Maintenance is more adequately organized, and roads receive closer and more constant attention. This will serve to decrease the reconstruction periods.

(4) A more accurate knowledge of traffic existing and

FIG. 11—REMOVING A LANDSLIDE

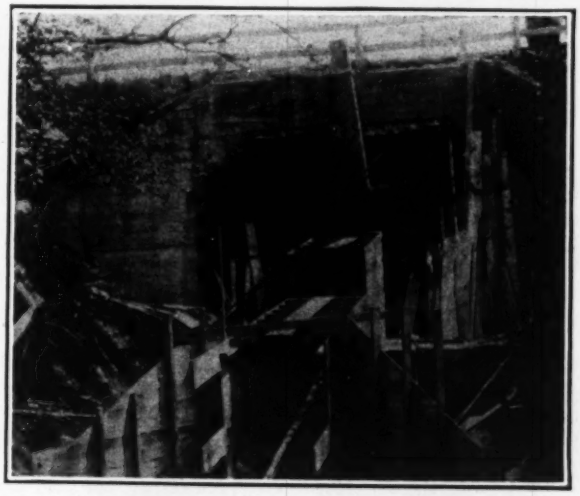


FIG. 10—EXTENDING CULVERT FOR WIDENING ROAD

projected will be very valuable in future road construction and maintenance. Many state highway departments haev made or are making full transport surveys.

In this connection about 40 per cent of the average road improvement consists of items on which the depreciation is practically negligible—the roadbed and drainage structures. It is true that in a few states maintenance expenditures are already equal to expenditures for construction. This is due, not so much to the fact that the main routes of travel are already improved, but because a large mileage of roads was designed and constructed when the traffic was light in volume and weight.

An interesting angle is the attitude of the highway contractors themselves toward this question. As would naturally be expected, they are as a rule ardent advocates of maintenance by contract. However, many of them realize that maintenance contract work, from its very nature, constitutes an effective training school for future competitors in the larger field of new construction.

Looking at the question from a personal—and somewhat narrow viewpoint, contracting maintenance work will serve to transfer many controversies and burdens from the highway official to the broad shoulders of the contractor. The policy will undoubtedly win increased support, of a substantial and legitimate nature, for a program of adequate maintenance, reconstruction, and widening of existing highways. The possible evil of building up, by those in power, of a large personal political following composed of employees on the public payroll is minimized. In view of the fact that, as our highway systems are gradually completed, maintenance in its broadest sense will become the major operation, performance by contract can well be classified as a forward-looking policy that will be for the ultimate good of the most remarkable development in transportation recorded in history—the motor vehicle and its highway.

[*The next article will be "Management of Highway Maintenance Equipment," by W. A. Van Duzer, deputy engineering executive, Pennsylvania Department of Highways.*—EDITOR.]

Durability of Concrete Aggregate

Comparison of three accelerated tests for the weathering resistance or durability of concrete aggregate has been undertaken at the Bureau of Standards on 36 varieties of coarse aggregate, representing the most commonly used types in this country (18 stones, 6 slags, and 12 gravels). Samples of 40 lb. were separately treated by the sodium sulphate, sodium chloride, boiling and drying, and freezing and thawing tests. The results to date indicate that there is little or no relation between the various tests. The limestones have shown the largest amount of disintegration. Granites have not been affected, and only occasional pieces of trap, sandstone and slag have shown signs of breaking up.

Movement of Mokelumne Pipe Line During Construction

Experimental Study of Creep Due to Temperature Changes—Analysis of Resulting Stresses in Pipe—Some Unrecognized Sources of Pipe Stress

DURING the period last year when difficulties were encountered in welding the field joints of the 65-in. Mokelumne water main of the East Bay Municipal Utility District (Oakland, Calif.), an elaborate investigation of the movements of the pipe line during construction, and the resulting stresses, was initiated. This was carried out for the district by Prof. L. T. Jones and Prof. W. S. Weeks, of the University of California. A remarkable record of pipe creep was obtained, and high stresses in the pipe were discovered, arising from a number of causes, some of them not previously recognized as being involved in the laying of pipe. In part, the movements and stresses are not related to the type of joint—whether welded or riveted—but apply to all pipe lines. One of the most serious stresses, namely that due to large difference of temperature between top and bottom of the pipe during the daytime,

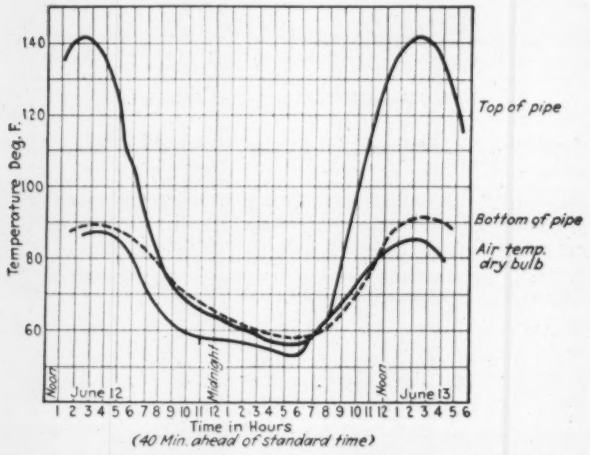


FIG. 1—TEMPERATURE CHANGES OF PIPE AND AIR, MOKELUMNE PIPE LINE

arises from conditions that are more extreme in California than in many other parts of the country.

In the following a very brief statement of the investigation is given, from the original report of Professors Jones and Weeks, followed by a summarized statement of deductions, drawn up by Professor Jones as conclusions applicable to pipe line work in general.

One of the conclusions of the authors directly relating to the Mokelumne pipe line is that "A 65-in. pipe line can be either electrically or acetylene welded without fear of breakage." A conclusion of more general application to pipe lines is that two important sources of longitudinal stress are present in all or nearly all pipe lines, though they have been generally ignored heretofore: A longitudinal tension of about one-fourth the circumferential water pressure tension, due to the Poisson contraction; and a longitudinal tension due to the fact that the water flowing through the pipe in service is colder than the pipe at the time it was constructed and connected up. For a circumferential working tension in the pipe of 13,000 lb. per sq.in., and water of 40 deg. temperature flowing through a pipe which was built and completed at 65 deg. temperature, these two longitudinal tensions are respectively 3,250 and 5,000 lb. per sq.in., or 8,250 lb. per sq.in. together. Because of this inevitable longitudinal tension, it is important that any avoidable longitudinal tensions be guarded against.

The Mokelumne pipe, which is 65 in. in diameter for the most part and is to be about 90 miles long, with shell thickness of $\frac{7}{16}$ to $\frac{1}{2}$ in., has shop welded longitudinal

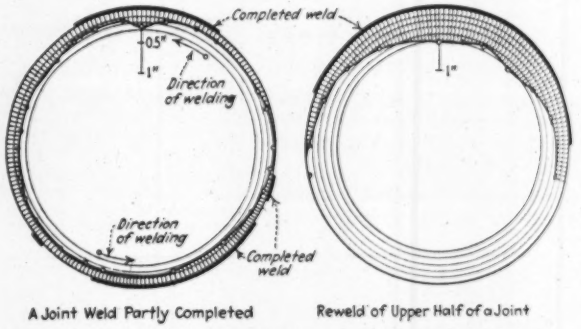


FIG. 2—RESIDUAL DEFORMATIONS DUE TO STRESSES SET UP DURING WELDING

seams and was to have its girth joints welded in the field by the acetylene flame. These two operations were described in *Engineering News-Record* of July 22, 1926, p. 128 and Dec. 2, 1926, p. 912. The welding of the field joints resulted in many breakages (sixty-eight) and was finally abandoned in favor of riveting, at the order of Arthur P. Davis, chief engineer of the district.

In laying the pipe, successive lengths were placed in the trench excavated for the line, the ring joints were welded, and backfill was placed on the middle part of as many of the pipe sections as possible to hold them in place, while the joints were left uncovered until water pressure tests could be made. The ring joints were welded from the outside, having previously been cut to form a single V-joint of 90-deg. angle. At first they were welded by oxy-acetylene flame from the outside only. The joints were later backed up by an electric-arc weld made on the inside. All the work was done in the daytime and the pipe was exposed to the heating effect of the sun's rays during the working period.

Temperature—Temperatures in the metal of the pipe as measured by the investigators ranged from 65 or 70 deg. F. at night to 95 or 100 deg. F. in the daytime, at the bottom of the pipe; and from 60 or 65 deg. at night to 140 and even to 160 deg. in the daytime at the top of the pipe. Under the backfill the temperatures varied but little, ranging between 85 and 90 deg. F. Fig. 1 shows typical curves of temperatures, respectively, of the air, of the bottom and of the top of the pipe, and

indicates a difference of about 40 deg. between bottom and top of pipe during most of the day. Joints made during the day were therefore subject to the development of a large tension at the top by cooling at night. The joints always broke at night, and in many instances before 9 p.m. The differences of temperature represented longitudinal stresses of 7,000 or 8,000 lb. per sq.in.

Welding Deformations—Deformations due to the progressive heating at the joints as the welding proceeded around the joints were measured in a number of instances. Two diagrams of longitudinal deformations of the pipe at the joints are shown in Fig. 2. One of these diagrams represents the result of rewelding the upper

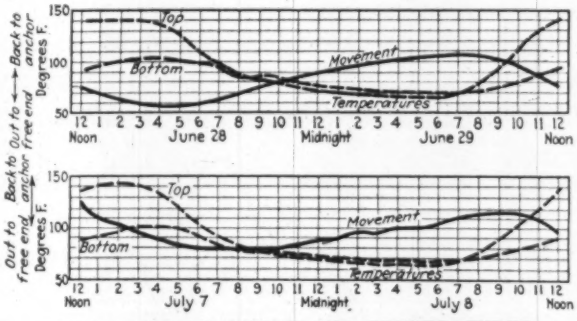


FIG. 3—PIPE MOVEMENT AND TEMPERATURES

part of the joint which had cracked, and here the deformations are particularly large. Measurements of longitudinal deformation at some distance from joints being welded showed that the deformations distributed themselves over a considerable length of pipe.

Longitudinal Pipe Creep—Longitudinal movements of the pipe were early observed, and they were measured by a variety of devices, including markers attached to the sides of the trench, plumb bobs suspended in the pipe to show differences of movement between top and bottom, and autographic recorders of movement with respect to the surrounding earth. A typical set of observations is plotted in the diagram Fig. 3, which shows two sets of curves, one representing the movement and temperature near the free end of the pipe line and the other the corresponding curves for a section some distance back of the free end. The relation between temperature and expansion movement is clearly brought out by these curves. In a section at the free end there is a stoppage of motion at about the time of reversal of temperature, but in a section some distance back of the free end the pipe continues to move forward even when the temperature is falling. In other words, at distances back from the free end the movement of the pipe is out of phase with the temperature; the rear part of the pipe continues to move forward at a time when the forward part, near the free end of the pipe, is already moving back through contraction. This indicates that the resistance is not simple friction, but is of viscous character. The authors suggest that this effect may be partly due to movement of the pipe inside its paper covering (such movement was observed by calipering between a point on the paper and a point on the pipe), but they believe that some of the viscous effect is due to the actual nature of the friction between the covered pipe and the soil.

This creep of the pipe was found to represent a frictional resistance of about 700 lb. per lineal foot of pipe. The pipe was in motion for a distance of about 40 lengths (of 30 ft. each) back from the free end, or in general a distance in feet equal to about 14 times the temperature range of the top of the pipe in degrees Fahrenheit. The authors call that point of the pipe at which motion ceases the "anchorage point."

Corresponding stresses in the metal of the pipe were measured by readings of elongation or shortening of practically a full pipe section by mounting on the section a comparison bar slightly over 29 ft. long, tack-welded to the pipe at one end but otherwise free longitudinally. Some of these bars were equipped with clock-driven recording devices for making autographic records of the stress, while in other cases readings were taken directly on the bars at short intervals day and night.

By this method the curves in Fig. 4 were obtained, showing stress developed in a length of pipe while a distance piece was being welded in to fill a short gap at a joint; the curves also contain stress readings taken on the same length a week later. The predominating influence of the daily temperature variation is evident. In this measurement a true zero was obtained as the gage bar was attached to the pipe before the pipe was con-

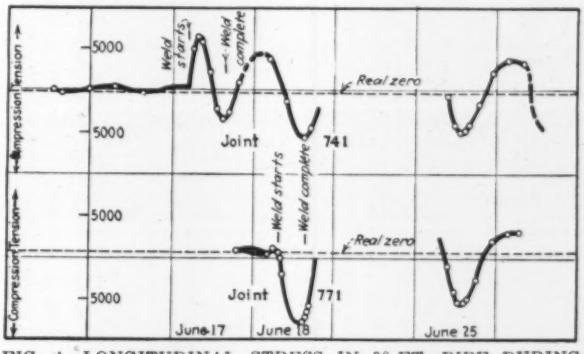


FIG. 4—LONGITUDINAL STRESS IN 30-FT. PIPE DURING WELDING OF A DISTANCE PIECE

Stress readings a week later are also shown. Abscissas represent time.

nected into the line. In the stress measurements plotted in Fig. 5 a true zero could not be obtained, as the pipe was already joined together in the line; the stress variations, however, are truly represented.

The curves in Fig. 5 were taken on $65 \times \frac{7}{8}$-in. pipe on every tenth section in a stretch of pipe line covering 40 pipe sections from the free end; bar 412, represented by the upper curve, was one section from the free end, and the other bars at successive intervals of 10 sections or 300 ft. farther from the free end. The solid lines represent stresses measured along the top element of the pipe, and the dotted lines stresses measured along the bottom element, the gage bar for the latter being mounted on the inside of the pipe. It will be seen that the daily range of longitudinal stress in the top of the pipe approaches 10,000 lb. per sq.in. The entire 1,500-ft. stretch of pipe covered by these measurements had backfill placed over the middle of each length of pipe, but the joints were still exposed.

As the single length of pipe from the free end to length 412 was not backfilled, the stress variations measured on 412 (upper curve in Fig. 5) are not to be attributed to longitudinal stress due to friction in the backfill, but represent differential temperature stress or bending; accordingly, the stresses in top and bottom of the pipe are in phase opposition. At distances far from the free end, however, the stresses in top and bottom of the pipe are practically in phase. The stresses measured

here are line stress due to motion of the pipe back and forth through the backfill and differential temperature stress.

At 20 lengths from the free end the top stress reaches practically a maximum, remaining fairly constant from this point farther away on the free end. The stress in the bottom of the pipe, however, continues to increase, though it is smaller than the stress in the top of the pipe.

A similar set of curves for joints 580, 640, 650 and 660 is shown in Fig. 6. The bars for 640, 650 and 660 were placed when the pipe sections involved were only held in position and not yet welded, so that the true zero lines of stress were known; the zeros are checked by stress observations taken May 30 and May 31, 1926, when no welding was being done.

The following condensed summary of conclusions has been prepared by Professor Jones to indicate the main features brought out by the study of pipe movements and stresses:

Operating Stresses—Suppose a pipe line is constructed to carry water under pressure and that during winter the water will have a temperature of 40 deg. F. A large part of the construction of pipe lines is accomplished during the summer months and frequently miles of line are completed without the metal of the pipe at any time falling below 65 deg. F. The line is thus constructed and buried. It will later be called upon to withstand a further drop in temperature of 25 deg. F., which will introduce a longitudinal tension, the *cold-water stress*, of 5,000 lb. per sq.in. This tension will be superimposed on whatever line tension the method of construction may have permitted to remain.

There remains one additional stress whose presence is inherent in the operation of the line and which has heretofore not been considered in pipe line construction. Metal subjected to a tension F in one direction will decrease its dimension at right angles to F by an amount equivalent to a stress kF, where k is a fraction that is constant for steel (Poisson's ratio). If a pipe line which cannot move longitudinally be subjected to a circumferential tension F it will thereby be also subjected to a longitudinal tension kF. Taking the value of k for steel as 0.25, a water-pressure stress of 13,000 lb. per sq.in. produces a longitudinal tension of 3,250 lb. per sq.in.

There is then present in this hypothetical pipe line a total operating tension of 8,250 lb. per sq.in. In view of the presence of this 8,250 lb. per sq.in. operating tension and a probable line tension of 8,400 lb. per sq.in., minimizing stresses wherever possible is desirable.

Constructional Stresses—During the construction of any pipe line by continuous laying, the free end of the pipe moves back and forth through a daily cycle caused by the sun's heat. This motion can be prevented in two ways: (1) by controlling the temperature, as by covering with dirt, or (2) by loading the pipe (either a constructed anchor or dirt covering). The pipe should always be backfilled at the coldest time of day in order that the force required to pull the pipe back through the dirt shall not remain as line tension.

If a pipe line partly covered by dirt (for example, each pipe section covered at the middle but the joints left exposed for inspection) cools and contracts, the line is in tension at the close of the movement of contraction and the temperature must rise sufficiently to remove this tension and introduce an equal compression before the motion of expansion can begin. The value of this tension or compression will be proportional to the distance from the free end of the pipe, and at some distance L from the free end there is a point beyond which no motion of the line takes place. This anchorage length is given by $L = C\,T$, where T is the temperature range and C a constant depending on the dimensions of the pipe and its loading.

If a pipe line be constructed by a continuous method the line stress will alternate between tension and compression and the maximum value of each will be half that calculated from the temperature range.

During a normal summer day the top of a large pipe line is frequently 50 deg. F. warmer than the bottom. If the joints are welded or riveted under this condition the top fibers may be under an excess stress (differential-

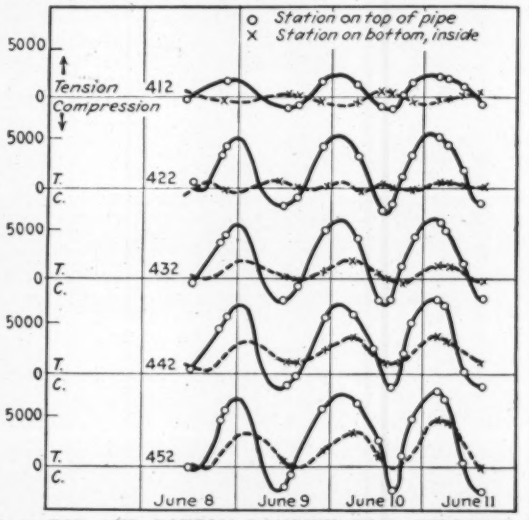


FIG. 5—TOP AND BOTTOM LONGITUDINAL STRESSES IN FIVE PIPE LENGTHS

The upper curve was taken in a length 30 ft. from the free end of the pipe line. The lower curves are for pipe lengths successively 10 lengths or 300 ft. farther away from the free end. Solid lines represent stress readings on the top of the pipe, dotted lines on the bottom of the pipe. The true zero line of stress is not known as the comparison bars were attached after the stretch of pipe involved had been welded. All lengths except 411 were backfilled between joints.

temperature stress) of 10,000 lb. per sq.in. when the whole line comes to a uniform temperature. Riveted joints have an advantage in that they slip and somewhat relieve this stress, although the slipping also promotes leakage. The ideal procedure would be to make all joints at night and backfill before the following day's temperature rise begins. This would minimize both line stress and differential-temperature stress.

Any pipe line constructed normally by either continuous process or group laying will be left with a residual line tension. If a line is to be laid on an incline construction should always proceed uphill in order that the gravitational component may oppose this inherent residual tension.

In constructing pipe lines, particularly of large diameter and thick metal, it is difficult to have the adjacent edges that are to form the girth joints in exact alignment. If these sheets are forced into temporary alignment during the making of the joint but the pipe is not permanently deformed to bring them into alignment there will be introduced in the completed joint a shear whose value will be the larger the thicker the metal of the pipe. This shearing force will show itself as a tension on the rivets of a riveted joint and a shear in the

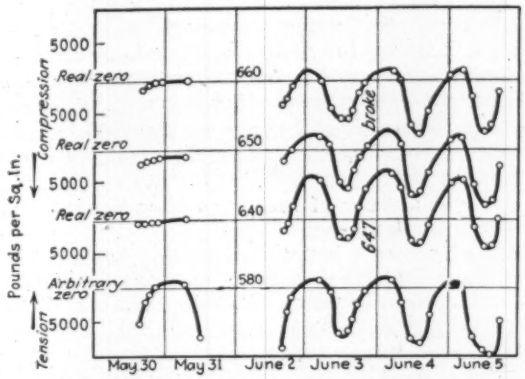


FIG. 6—STRESS VARIATIONS IN FOUR PIPE LENGTHS DURING A THREE-DAY PERIOD

Gage bars placed on May 29, when 660 was the end length.

weld metal of a welded joint. This shear should never be permitted to exist. Ends of pipe sections that are to be joined, particularly by welding, should be as nearly round as possible and should be permanently deformed if necessary, to bring the sheets into alignment for joining.

Constructional stresses, except possibly shearing stress, are not great and each may be minimized by proper procedure. Differential temperature stress and shearing stress should never be permitted. Gravitational stress is a friend. Line stress may be reduced to almost any desired amount.

Definite and suitable procedure to minimize constructional stresses is valuable insurance obtainable at a reasonable cost.

Everglades Drainage Plan Endorsed with Minor Changes

Board of Review Approves Work—Recommends Larger Outflow Capacity for Lake and Shorter Drainage Canals

AN engineering board of review recently completed a study of the Everglades drainage work at the request of the commissioners of the Everglades Drainage District of Florida. It reports under date of May 3 that the plan on which the drainage work has heretofore been carried out (the Isham Randolph 1913 plan) was the proper plan to follow; that the administration of the work by the commissioners of the district has followed this plan except in respect to certain details which were wisely changed; that the engineering work has been carried out competently and efficiently; and that no evidence can be found to indicate that the money spent for Everglades drainage construction has been spent otherwise than economically. Some modifications of the general drainage plan are recommended by the board, however, in the light of the facts as they have developed in the course of the work. The board consisted of Dean Anson Marston, of Iowa State College; S. H. McCrory, of the Division of Rural Engineering, Bureau of Public Roads; and George B. Hills, consulting engineer, of Jacksonville.

Chief of the recommendations of the board for modification of the project are:

(1) That the lower and upper limits of the level of Lake Okeechobee shall be fixed respectively at 14.0 and 17.0 ft. above mean low water in the gulf, instead of 16.0 and 19.0 with possible occasional rises to over 21 ft. as recommended by the Randolph commission. The change is in agreement with conclusions already reached by the commissioners of the drainage district and their engineers, and finds its reason in the unexpectedly great subsidence of the muck soils around the south end of the lake, which subsidence has already reached 3 to 4 ft. and is still increasing, while the Randolph commission estimated that it would be less than 8 in.

(2) That the outlet canal capacity be increased either by deepening the St. Lucie canal 5 ft. to increase its capacity from 5,000 to 7,500 sec.-ft. or by enlarging the Caloosahatchee canal. The 7,500-ft. capacity will be ample, it is held, to prevent the lake from rising materially above El. 17.0, and the board urges that the control canals be operated with constant watchfulness to hold the lake from rising higher (by opening the canal gates when the lake stage reaches 14.5 on a pronounced rise, and keeping them open at all times above stage 15.0). As to the lower limit of lake level, it believes that during years of low rainfall it may prove impracticable to prevent occasional recession of the lake to a level below 14.0.

(3) That a greatly enlarged and highly safeguarded levee be built around the southwestern, southern and southeastern shores of the lake, from a point about 3 miles northwest of Moorehaven to about 2½ miles southwest of Pahokee (and possibly farther north, subject to later detail surveys and studies). This levee is to be built to El. 27.0, or 10 ft., above maximum lake level, and is to have its lakeside slope and crest ripraped with rock 3 ft. deep.

(4) That an east-west series of drainage canals be laid out in place of the existing project for diagonal canals (of which seven have been built). The new canals are to run due easterly from the lake or from the existing diagonal canals. The new system will give shorter canal length and increased slope. As outlined by the board, canals would be located 5 or 6 miles apart, from Canal B at a point some 10 miles north of Palm Beach to Canal S at Miami and two short canals south of this point. These drainage canals are not be used for lake control, but are to serve only as outlets for subdrainage districts in the Everglades, these sub-districts to be leveed and pumped by their owners. The canals would be adequately diked and would be designed with advance provision for subsidence of the soil as much as 3 ft. below existing levels where the existing thickness of muck is 6 ft. or more.

In addition, the Board of Review recommends that all future drainage work be progressive, rather than that an attempt should be made to construct in one continuous project within a fixed period of years the whole system of canals. The area that will be given outlet drainage by the system is so great as to require a period of many years to bring it under actual occupation and successful cultivation, and drainage should not be provided faster than the land can be brought into use.

The works recommended will cost in their entirety in excess of $25,000,000, of which sum the drainage canal system accounts for $22,000,000. The improvements urgently needed, however (completion and protection of St. Lucie canal, construction of Lake Okeechobee levee, and provision of 2,500 sec.-ft. additional outlet capacity), will cost only $3,000,000. The order of work on the drainage canals, it is recommended, should be determined by the commissioners of the district after full study of local conditions and possibly public hearings.

Factors Affecting Use and Cost of Reinforced-Concrete Buildings

Careful Economic Studies Preceding Design Layout Are Valuable—Graphs of Relation of Various Factors to Cost

By W. W. Hay

Mack-International Motor Truck Corp., New York City

STUDIES preliminary to the actual design and layout of buildings for industrial purposes are often too much neglected by engineers and architects. These studies are largely of an economic nature. They include as their more important factors natural light or width and number of stories or height but are also concerned with type of occupancy and as corollaries probable loads and column arrangement and spacing. All have a marked effect upon the use and cost of the building.

This article relates only to multiple-story reinforced-concrete structures of the usual industrial type, rectangular in plan, up to six stories in height, and of flat slab construction. There are too many lateral considerations in single-story construction which place it beyond the range of this discussion. It should not be overlooked that the data in this article are intended for use only for preliminary studies and estimates and in order to make comparisons. When it is apparent by comparison that there is a choice of width, of number of stories, of spacing of columns, or of other elements, then a more detailed study and estimate can be made with considerable faith that it will be useful.

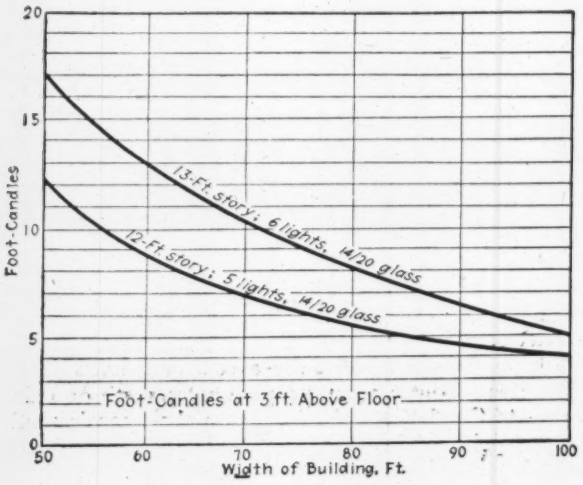


FIG. 1—NATURAL LIGHT AVAILABLE ON DULL DAY IN CENTER OF BUILDINGS OF VARIOUS WIDTHS

Careful studies for economy of construction and with a view to future usage will aid in producing a structure suitable for long-term investment and maximum sale value. The plant designing engineer will often find such studies of great assistance in economically providing a maximum of space.

Width and height have a greater effect on the cost than floor loads or column spacing. Width is affected by conditions of the site and by requirements for natural light. Height is affected by purpose and by land values. For all manufacturing, the width is and should be determined by natural lighting and for all other purposes by the cost. The natural light necessary for different machine-tool operations has a direct bearing on the width necessary to secure such light. Similarly, the grouping of machine tools has a bearing on the width of bays within a building and the number of such bays often determines the width for that purpose.

Current research in artificial lighting has established three zones for all machine-tool operations, resulting in minimum widths to secure the desired amount of equivalent natural light. Fig. 1 shows the natural light that may be expected in the center of buildings of various widths up to 100 ft. where the light is sufficient for rough machining, storage, etc. The effect of increasing the floor height from 12 ft. to 13 ft. is shown to be considerable, and a comparison of costs will show very plainly the advantage of the higher ceiling in a wider structure. Widths of 70 to 90 ft. will provide sufficient light for the greater number of industrial operations. The narrower widths are best for fine machining, such as on gears and spring and screw products, and for such specialized work as that on shoes, locks and hardware, cabinet-making, watch-making, typewriters and adding machines. Buildings above the width of 90 ft. are used for printing plants, packing and distribution warehouses, and for manufacturing clothing, textiles, and other products in which artificial lighting supplements natural light. It should be remembered that in all warehouses and distribution stations where a full bay is required for trucking, an odd number of bays is necessary; this has a marked effect on the width of the building or the column spacing.

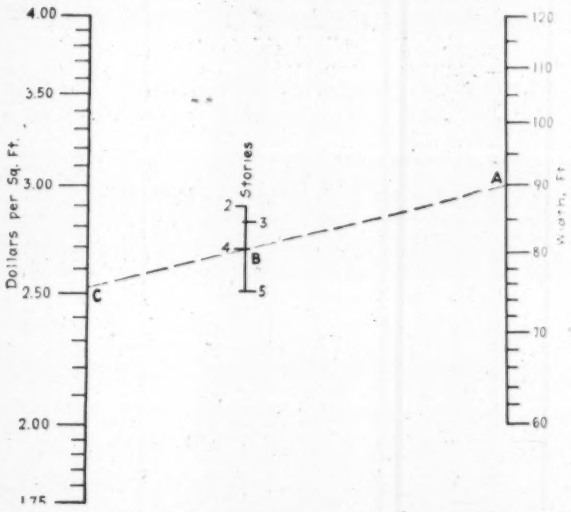


FIG. 2—RELATION OF COST TO WIDTH AND NUMBER OF STORIES

Refers only to buildings having length greater than twice the width.
To use graph, enter on width *A*, pass through number of stories *B* and read cost *C*.

The effect on cost of width and number of stories is shown by Fig. 2, for ordinary widths of from 60 to 120 ft., and for buildings two to five stories in height. Fig. 2 may be used for any one of the following three purposes: to compare cost of variation of about 20 ft. in width and no change in number of floors; to compare

cost of space in fixed width of buildings with variable stories; and to estimate cost of total space in L-shaped, U-shaped or F-shaped buildings made up of various widths and number of stories. This graph is based on the actual contracts placed for a large number of buildings of the ordinary type considered, erected during the last two years. The writer has found the figures to be sufficiently accurate for the use intended, which is as stated for preliminary estimates only. The cost given is that of foundations, structural frame, roof, side walls, doors, shafts, service bays and stair tower, i.e., the general contractor's work, without plumbing, heating, wiring or sprinklers. An amount varying from 75c. per sq.ft. for 60 ft. wide to 60c. per sq.ft. when 120 ft. wide is

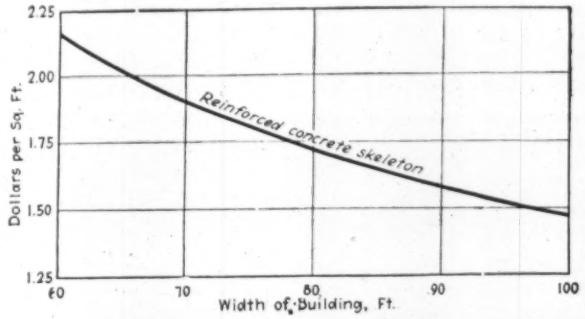


FIG. 3—SQUARE FOOT COST FOR REINFORCED-CONCRETE FRAME FOR BUILDINGS OF VARIOUS WIDTHS

usually sufficient to cover the cost of the usual plumbing, radiation, and lighting.

The cost of the reinforced-concrete frame for buildings of various widths is shown by Fig. 3, and for obvious reasons this cost is not appreciably affected by the number of stories considered here. Height largely governs the construction, as one operation must follow another, whereas the ground area has little effect—it is a question of size of plant and the number of men.

While the spacing of columns has an effect on the cost (Fig. 4) due to increasing spans, there is seldom much choice on account of other influencing factors. It has been determined that the most economical spacing of columns for usual loads is about 18 ft. but this spacing is only adaptable for warehouses and where the machine tools are small. The so-called "standard" buildings have the columns spaced 20 ft., which is an economical spacing for the live-load in use for such types. The effect of live-load on the cost is shown by Fig. 5, but the live-load, too, is generally fixed by the occupancy and hence not often an economic factor. The live-load for most industrial uses, and for storage or distribution occupancies, should not be less than 150 lb. per sq.ft. and should preferably be 200 or 250 lb. per sq.ft.

Following the recent published findings of public bodies interested in securing revisions downward of the live-load requirements of building codes, there has developed a disposition on the part of commercial designers for speculative buildings to "cut" the floor load in the interest of economy. This the writer thinks is a fallacy since most structures of this type are more likely to be overloaded than not and the light load capacity will prove to be a penalty when ready for lease or sale. In particular, when a business develops and the building must be added to, it should be possible to shift departments at will and not be limited by light capacity floors. One phase of industrial loading that should be provided for is the vibrations set up by most machine tools, either on the bed or transmitted to the shafting by the belts. The effect of this vibration is most severe on light floor systems. An increasing number of permanent buildings of the type discussed is being erected by speculative builders for sale and by investors for comparatively

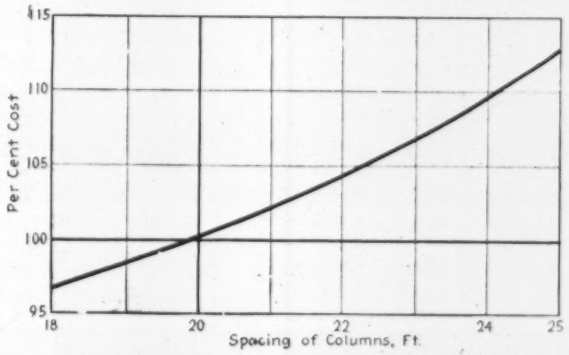


FIG. 4—RELATION OF COST TO COLUMN SPACINGS
Referred to cost of "standard" building with columns spaced 20 ft.

short-term leases to desirable tenants. Whether building for occupancy or for lease, too great care cannot be exercised that the development of suburban industrial areas into urban limits during the early life of the structure does not lead to obsolescence.

The layout and type of construction are determined by occupancy and should be based on production requirements and in part on maintenance. Different industrial operations have established definite space and light requirements, yet the principles underlying the design of such buildings will be found to apply generally to all

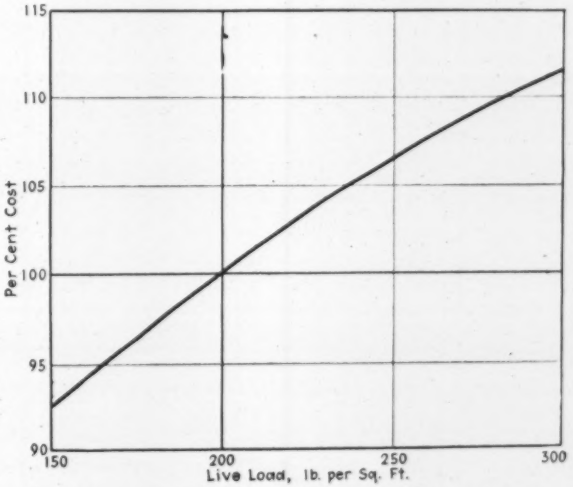


FIG. 5—RELATION OF COST TO FLOOR LIVE-LOAD
Referred to cost of "standard" building with load of 200 lb. per sq.ft.

buildings of multiple stories for industrial use. Individual buildings should be standard, with normal floor loads, normal column spacing, and normal windows, thus increasing the sale value, or, in the case of leased buildings, the rental value. For the building to serve to its greatest capacity, questions of design and construction should be considered as a whole with purpose and maintenance, and the choice made by experience and based on cost.

Articulated Locomotive Operates on 7½ Per Cent Grades

Train Loads and Speeds Increased as Compared with Geared Engines on Mountain Line with 66-Deg. Curves

INCREASING the traffic capacity of a railroad in the Rocky Mountains having grades of 7½ and 5 per cent on both sides of a summit, combined with numerous curves as sharp as 66-deg., was a problem faced by the Uintah Ry. about a year ago. Relocation would have been of prohibitive cost, even if found practicable, but the problem was solved by the introduction of powerful locomotives of the articulated type, Fig. 1, to negotiate the sharp curves. In the case of another small Rocky Mountain railroad whose grades limited its traffic capacity, the problem was solved by building an entirely new line with easier grades. This was the Kenilworth branch of the Denver & Rio Grande Western Ry., described in *Engineering News-Record* of Feb. 24, 1927, p. 315.

The Uintah Ry., of 3-ft. gage, extends from Mack, Colo., on the Denver & Rio Grande Western Ry., north 63 miles to Watson, Utah, with a four-mile branch to Rainbow. From the profile, Fig. 2, it will be seen that for about 28 miles, from Mack to Atchee, its grades range from 1.22 to 3 per cent, but after a short stretch of 5 per cent comes a climb of 7½ per cent for six miles to the summit in the Baxter Pass, at El. 8,437. From this summit, the grade descends at 5 per cent for seven miles to Wendella, beyond which the grades range from 3.5 to 1.1 per cent. The Rainbow branch, however, has grades of 3.7 to 4.6 per cent. On twelve miles of the summit line, between mile-posts 28 and 40, there are no less than 233 curves, ranging from 4 to 66 deg., or with a minimum radius of 87 ft. That means nearly twenty curves per mile.

A large part of the railway's business is handling gilsonite from Utah mines for shipment over the Denver & Rio Grande Western Ry., but with the slow speeds and light train loads on the heavy grades the traffic has become seriously hampered. On the summit line between Wendella and Atchee, Fig. 2, geared locomotives were used to handle freight, and a direct-connected 0:6:2 tank engine hauled a single 35-ton passenger car. Freight engines of the 2:8:2 type, having a tractive power of 30,000 lb., operated on the easier grades at the ends of the line.

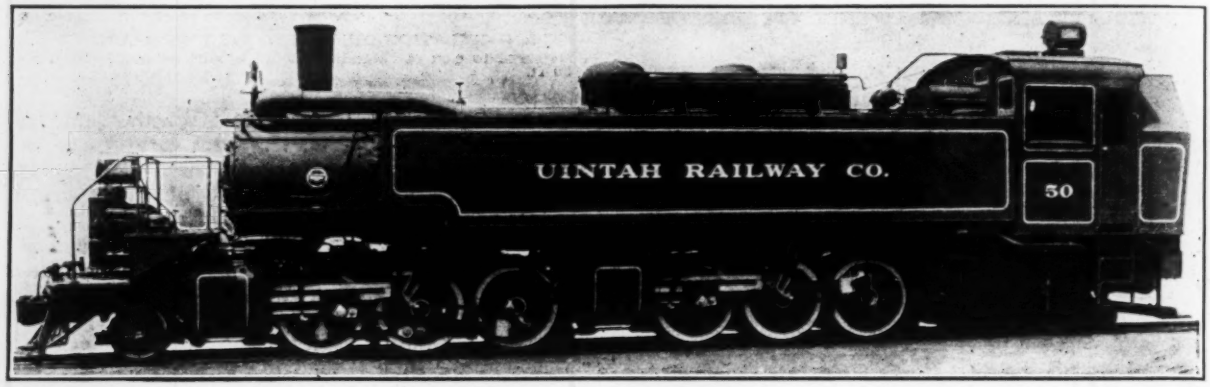


FIG. 1—MALLET ARTICULATED LOCOMOTIVE FOR UINTAH RY.
Takes 240-ton train up 7½ per cent grade having 66-deg. curves.

To overcome these difficulties and increase the traffic capacity an engine of the Mallet articulated type with 0:6:6:2 wheel arrangement, Fig. 1, was specially designed by the Baldwin Locomotive Works. It is a tank engine, with about 82 per cent of its weight carried on the driving wheels. It has a tractive force of 42,100 lb., driving-axle loads of about 16 tons, and a rigid wheel-

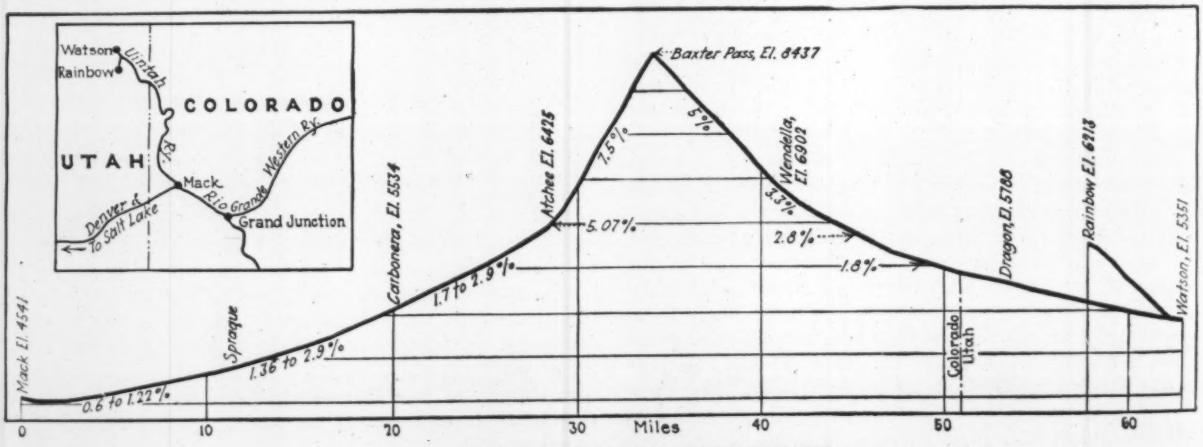


FIG. 2—MAP AND PROFILE ON UINTAH RY.

base of only 7 ft. 8 in. Its main dimensions are given in the accompanying table:

This new type of articulated engine has replaced not only the general engines and the 2:8:2 freight

MALLET ARTICULATED LOCOMOTIVE, UINTAH RY.

Cylinders, four ...15x22 in.	Heating surface 2,100 sq. ft.
Driving wheels, .. diameter .....3 ft. 6 in.	Superheating surface .....505 sq. ft.
Wheelbase, rigid ..7 ft. 8 in.	Boiler, diameter ..5 ft. 4 in.
Wheelbase, total..38 ft. 3 in.	Firebox 9 ft. 10 in.x5 ft. 6 in.
Weight on driving wheels .....194,500 lb.	Steam pressure ....210 lb.
Weight, total....236,300 lb.	Tank capacity ...2,800 gal.
	Bunker capacity ...9,000 lb.

engines, but also a small saddle-tank engine which was used at the mines, where the curves were too sharp for the ordinary freight engines.

Operating conditions on this steep grade line are particularly interesting. From Rainbow, Utah, to Dragon (see Fig. 2), the articulated engine will haul 1,150 tons; and then 525 tons to Wendella on grades varying from 1.73 to 3.34 per cent. The 2:8:2 engines could handle only 650 and 325 tons, respectively. From Wendella to Baxter Pass, the new engine takes 240 tons up the long 5 per cent grade, while two geared engines, each of 20,000-lb. tractive power, could take a train of only 210 tons. Furthermore, the former makes the run in 1 hr. 10 min., while the latter required 2 hr. 20 min. From Atchee to Baxter Pass, the new engine takes 145 tons up the six miles of 7½ per cent grade, as against a 120-ton train for two geared locomotives. The average week-day tonnage over the line is 600 tons in each direction. To insure safety in descending the 7½ per cent grade, the pull-rods in the foundation brake gear are fitted with turnbuckles, so that all slack or false travel can be taken up before the train starts down the grade. This arrangement eliminates the necessity of using the hand brakes. The speed limit is 6 m.p.h.

L. C. Sprague is vice-president and general manager of the Uintah Ry., and F. G. Morss is chief engineer.

Concrete Buildings and Tanks on a French Railway

IN RECONSTRUCTION of its lines through the war-devastated districts of France, the Northern Ry. has made extensive use of reinforced concrete for bridges, buildings, water tanks, and miscellaneous structures, on account of the economy in first cost and maintenance cost

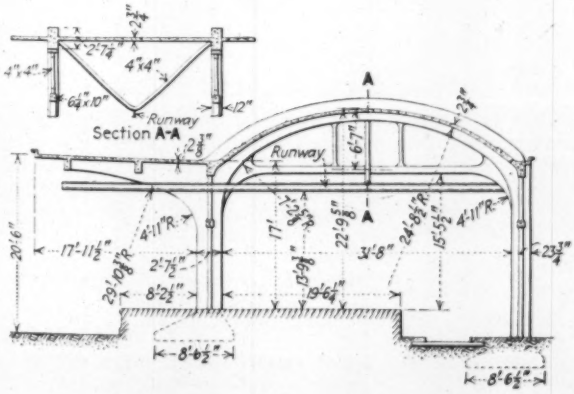


FIG. 1—CONCRETE FREIGHT STATION

and the increasing cost of labor in both construction and maintenance work. Two examples, as illustrated in the *Railway Gazette*, London, are shown herewith.

Concrete water tanks of various sizes and designs are used to a great extent, but reinforced-concrete water columns, Fig. 2, are decidedly novel. On the fixed concrete post or column of ornamental design revolves an arm or pipe of the same material with an iron pipe and spout pivoted to the end for adjustment to the tender manhole.

In the design illustrated, the arm is revolved by means of a vertical endless chain operating a small bevel pinion engaging a circular rack, but the mechanical details vary in different designs. A loose chain provides for swinging the jointed arm into position, and a lever with spring latch operates the valve. Besides the saving in first cost and maintenance as compared with iron water columns, there is said to be a saving by the elimination of precautions against freezing, owing to the low conductivity of the concrete.

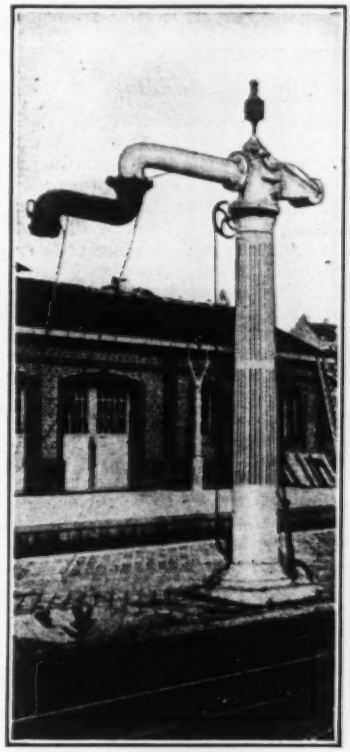


FIG. 2—CONCRETE WATER COLUMN

A standard design of freight station, Fig. 1, has an arched roof spanning a broad platform and one track, while an 18-ft. cantilever roof extends over an outside platform and track. A transverse I-beam carried by V-hangers from the roof ribs forms a runway for a trolley hoist. A somewhat similar design of arched roof is used for rectangular enginehouses, each span covering two or three tracks and the working spaces between them. These enginehouses are much more lofty than in American practice, but as there is no monitor roof, ventilation is provided by a row of closely spaced tall flues, or chimneys which are built over each track.

Some of the large engine terminals have double-track water-filled ashpits of the American type, the pits being of concrete faced with brick. Reinforced-concrete posts and girders carry the outer rail of each track over the sloping side of the pit. At Aulnoye, where two parallel pits are required, a long traveling gantry crane, with cantilever extensions, carries a trolley with grab bucket for removing the ashes and delivering them to cars on a fifth track or beyond this to a storage hopper. This crane serves also to unload coal from cars to a storage pile and to rehandle it to the bins of the coaling station.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Drills in Big Bend Tunnel

Sir—Can some reader tell me whether a steam drill was used at the Big Bend Tunnel or not? This tunnel is on the Chesapeake & Ohio Ry. in West Virginia, and was built between 1870 and 1873. I have heard that a steam drill was tried out but was unsuccessful, but I have been unable to verify this.

GUY B. JOHNSON,
University of North Carolina.

Chapel Hill, N. C.,
July 25, 1927.

Timber-Frame Industrial Buildings

Sir—With reference to the matter on timber-frame multi-story industrial buildings, published in *Engineering News-Record* July 7, pp. 2 and 20, I would have liked both the article and editorial better if they had given a somewhat broader viewpoint of the matter of fire hazard and fire protection. The average executive planning to erect a building does not think beyond fire insurance premiums and building code requirements. He does not realize the indirect costs of fire in the shape of interruptions to business or disruption of personnel. We are constantly striving to educate business executives along these lines. Frequently the nature of a business is such that the importance of fire safety far transcends the minor question of the savings of a few dollars in insurance premiums.

It is true that a properly constructed heavy timber building is relatively desirable from the fire safety viewpoint, if equipped with automatic sprinklers. It is better than a similar building with a steel frame unprotected, but not so good as a concrete building, assuming all three to be sprinklered. Ordinarily, sprinkler protection is a larger factor in fire safety than is the character of the building.

One important point which was not mentioned is that of waterproofing the floors, which is apt to be a troublesome problem in a timber-frame building. If floors are not waterproofed, a fire on an upper floor may cause great damage to the lower floors.

R. S. MOULTON,
Assistant Secretary, National Fire Protection Association.

Boston, Mass.,
July 18, 1927.

Earthquake Construction in Messina

Sir—An article in your issue of June 30 on an insurance survey of earthquake damage risk prompts me to present the following description of standard anti-earthquake construction as adopted by Italian engineers for the reconstruction of the city of Messina. It was my privilege several years ago to investigate this matter personally while making a study of conditions there.

Excavation is carried 2 to 3 ft. deeper than is required for building foundations, and this space, together with the backfill volume around the walls up to grade, is filled with broken stone or gravel so that the building will rest upon and in a bed of crushed stone or gravel independent of the native soil, thus permitting the building to shift somewhat in its own bed and providing a base composed of material of a different and more resistive sort from the native soil surrounding it.

The foundations and framework are constructed largely of reinforced concrete, using a number of small bars rather than a few large bars, in such manner as to provide beams under all walls and at intervals not over 6 ft. apart in both directions over all areas. The bars are securely fastened together at intersections, and the beams are flared sideways for a distance of about 3 ft. from the joints, permitting the bars to be laid slightly diagonal as for a kneebrace. Reinforced-concrete columns are provided at all wall intersections and on either side of all openings, the reinforcement in the columns being tied into the beams at the foundation floor level.

Wall construction is generally of brick, and the columns are spaced so that no brick panels will be over 6 ft. square. This is accomplished in a curious and rather economical manner. The brickwork is carried up ahead of the concrete and left in dovetail form at the columns. Form boards are then placed on the two remaining open sides of the columns, and the concrete is poured. Thus the brickwork makes a dovetail form a half brick deep at alternate courses and the concrete is rammed into these spaces. It is claimed that this effectively prevents the brick panels from falling. The interior finish on the walls, floors and ceilings can be carried out as it is in houses in the United States, although the use of wood is minimized as much as possible to reduce the fire hazard. At about the mid-height of each story, and not over 6 ft. from the floor, there is a horizontal reinforced-concrete girt so that the height of the brick panels will not exceed 6 ft.

It is claimed that the resulting building is sufficiently rigid to be tipped entirely over without breaking the concrete or causing the brick panels to fall out. Most of the buildings are two or three stories in height, exclusive of the basement, and except for the additional reinforcement the cost is not much greater than for first-class fireproof construction.

A. BYRON HUNICKE,
Assistant District Manager,
The Foundation Co.

Chicago, Ill.,
July 7, 1927.

Large Steel Slabs Readily Available

Sir—Referring to the article by R. Fleming, "Proportioning Steel Slabs for Column Bases," in your issue of June 9, p. 941, we wish to correct the statement that slabs of certain dimensions cannot be secured without considerable delay. As a matter of fact, we have in stock plates from which slabs of the dimensions referred to can be cut, and, if necessary, planed and drilled for shipment in less than a week. Not only can we furnish slabs of the sizes and gages referred to, but of thicknesses up to 8 in., 9 in., and heavier. We might mention that we regularly prepare a circular showing the various gages we are in position to furnish, some of these plates being as long as 40 ft. and more. Mr. Fleming's article leads the engineer to feel that slabs in excessive dimensions cannot be secured, and we wish to correct this impression and to advise that we can supply these slabs for prompt shipment.

We operate a 206-in. mill, the largest in the world, in which we are regularly called upon to produce plates of heavy gages in large sizes. In this large mill we roll rectangular plates up to 196 in. wide, and we have furnished plates even as heavy as 12 in. thick. It may be of interest to state that we recently supplied blanks 195 in. in diameter, from which flywheels were machined.

GEORGE A. CARDWELL,
Lukens Steel Co.

Coatesville, Pa.,
July 26, 1927.

More on Concrete Mix Timers

Sir—Two ingenious devices for timing concrete mixes have recently been described in *Engineering News-Record*, one in the issue of April 14, p. 623 and July 14, p. 74: the first made of two fruit jars, and the second made of two electric lamps. Both are ingenious but neither seems so simple as stepping into a ten-cent store and buying an ordinary egg time hour-glass mounted on a card. By filing off the point at one end enough of the sand can be released to leave the necessary remainder for the desired time, and the glass can easily be fused together again.

E. E. HOWARD,
Harrington, Howard & Ash,
Consulting Engineers.

Kansas City, Mo.
July 18, 1927.

News of the Week

Current Events in the Civil Engineering and Contracting Fields

H. K. Wicksteed, Ry. Locating Engineer, Dies

Henry K. Wicksteed, consulting engineer, Canadian National Railway System and formerly chief locating engineer, Canadian Northern Ry., died July 25 in Toronto at the age of 72 years. Mr. Wicksteed was born in Quebec, and graduated from and took postgraduate work at McGill University. From 1874 to 1885 he was engaged on surveys for the Canadian Pacific Ry. and in 1887 was chief engineer of the Brantford, Waterloo & Lake Erie Ry., now the Toronto, Hamilton & Buffalo. Later work included double-tracking other work for the Grand Trunk Ry., and location of the Nipissing & James Bay Ry.

Mr. Wicksteed's most notable work was done while he was chief locating engineer of the Canadian National Ry. in the period between 1899 and 1921. The skill displayed in that work won him great distinction and resulted in his being called in as a consultant on many railway projects. Within the past two years, when he was close to seventy years old, he was asked to undertake the difficult task of making a reconnaissance survey for the Abitibi Southern Ry. across the lake region of Western Quebec. Subsequently he contributed an article to *Engineering News-Record* on the use of aerial surveying methods on that work.

Mr. Wicksteed was a member of the Engineering Institute of Canada and an associate member of the American Railway Engineering Association. In 1923 he was elected a fellow of the Royal Geographical Society.

Power of Congress Over Navigable Water Declared Absolute

The powers of Congress over navigable waters, even to the extent of obstructing them, was declared to be absolute in the decision rendered in a suit brought in the Fifth Circuit Court of Appeals to stop the dredging operations being carried on by the Arundel Corporation of Baltimore for the United States government at Miami, Florida. The bill stated that the Arundel Corporation has a contract with the United States to dredge a ship canal in the harbor of Miami, Fla., 200 ft. wide, to a depth of 25 ft.; that the excavated material is deposited at a point in Biscayne Bay about 2,000 ft. east of Miami Bay Park; that this is being done pursuant to an agreement between the Arundel Corporation and the city officials for the purpose of building up an island on which the city intends to build wharves, warehouses, a sewage-disposal plant and other "objectionable" structures; and that, in consequence, the value of the plaintiffs' and other property will be greatly diminished.

On this point the court said:

"It clearly appears that appellee is proceeding with the execution of a contract for harbor improvement made with the United States by authority of Congress and is doing the work according to specifications with the approval of the Chief of Engineers.

"The suit is brought ostensibly to abate a nuisance. Undoubtedly an obstruction in navigable waters is a nuisance and may be abated in a proper proceeding. However, it is well settled that Congress has complete dominion over the navigable waters of the United States, whether wholly within the boundaries of a state or otherwise, and has authority to undertake and prosecute such work as may be thought necessary to improve their navigability. This authority includes the power to obstruct and when Congress gives consent to the creation of an obstruction to navigation, it ceases to be a nuisance and the courts are powerless to interfere."

Engineering Fifty Years Ago

From *Engineering News*, August 4, 1877

THE Southern Pacific and the Central Pacific, the two great railroads of the Pacific Coast, have joined interest lately and they have commenced grading the next 600 miles through Arizona to Tucson, where a branch will run to Prescott, the capital of Arizona and then straight on through the state to Ft. Bliss on the Rio Grande. The Southern Pacific will have intercommunications with the Gulf of Mexico and take freight from Matamoras and New Orleans direct to San Francisco, supplanting the Vera Cruz and Aspinwall routes and supplying all the forts along the Rio Grande from Santa Fe to Matamoras with troops and war materials.

Appoints Registration Board for Pennsylvania Engineers

Under the act for the regulation of the practice of the profession of engineering and land surveying Governor John S. Fisher on May 6, 1927 appointed the following men members of a state registration board:

Richard L. Humphrey, Philadelphia; Henry S. Drinker, Merion; Abraham B. Clemens, Scranton; J. S. Chester, Pittsburgh; John S. Wise, Jr., Allentown. On July 22 the Board elected Mr. Richard L. Humphrey, president and C. R. Potteiger, secretary.

Revised Plans for Railway Line In Texas Approved

Plans of the Waco, Beaumont, Trinity and Sabine Ry. for the construction of certain new lines in Texas have been approved, conditionally, by the Interstate Commerce Commission. Construction of part of the new railway line proposed by this company was approved by the commission in 1925 and subsequently application was made for the approval of additional new construction, but changes in plans and local conditions have required the commission to give further consideration to the matter and issue new orders approving the work.

The construction as now approved consists in an extension of the railroad's present line from its terminal at Livingston in Polk County, Texas, southeasterly through Polk, Hardin and Jefferson counties by way of Beaumont to Port Arthur, Texas, also an extension from Weldon in Houston County northwesterly through Houston, Madison, Leon, Robertson, Limestone, Falls and McLennan counties to Waco, also a belt line passing through the city of Beaumont. Certain portions of the two major lines are to be built only in case the railroad company cannot obtain trackage rights over existing lines. The total length of the lines will be about 190 miles.

The certificate authorizing the construction of the lines is issued upon the express condition that construction shall be commenced on or before Dec. 31, 1927, and completed before the end of 1929. No method of financing was presented to the commission.

Extensive Bus Line Contracts Awarded in New York City

Contracts for the operation of buses in the five boroughs of N. Y. City which have been the subject of controversy during the past year and a half, were awarded July 29 to three companies. The Equitable Coach Co., backed by J. G. White & Co., the American Car & Foundry Co. and the Fajeol Corp. were awarded the franchise for Manhattan, Brooklyn and Queens. The Bronx bus franchise was awarded to the Surface Transportation Corp., a subsidiary of the Third Avenue Railway Co., and the bus franchise for Staten Island was awarded to the Tompkins Bus Corp.

In the Equitable company's award the longitudinal routes on Manhattan, which were the chief cause of former opposition to this contract, were eliminated, leaving only the cross-town routes in that borough.

The Equitable Coach Co., under the terms of its franchise, will operate seven

cross-town routes in Manhattan, 24 in Brooklyn and 25 in Queens. The fare will be 5 cents with three zoned routes in Queens. The charge for transfer will be 2 cents. The company has announced its readiness to make an investment of $16,000,000 or more, the city to receive 5 per cent of its gross receipts with a guaranteed minimum return of $400,000 a year. The franchise is for a period of five years with privilege of renewal for 5 years more.

The Surface Transportation Corp. will operate twelve routes in Bronx borough. It will charge a 5-cent fare in four zoned routes and will also return to the city 5 per cent of its gross receipts.

The Tompkins Bus Corp. will operate 18 routes on Staten Island charging a 5-cent fare in three zones and returning 3 per cent of its gross receipts to the city.

Expenditure of $1,569,887 for Vancouver Harbor Authorized

Expenditure of $1,569,887 for harbor development at Vancouver, B. C., has been authorized by an order-in-council of the Dominion government. The major portion of the appropriation will be spent on the north shore for obtaining terminal railway right-of-way, extension of trackage, establishment of storage yards, and construction of a tunnel under Lonsdale Ave. Included in the appropriation is $229,390 for reclamation and development of an industrial area in North Vancouver.

Mid-Hudson Bridge Caisson Lists in Sinking

A large open-dredged caisson for one of the Mid-Hudson bridge piers at Poughkeepsie, listed to an angle of 40 deg. on July 27, while being sunk. Examination by divers subsequent to the accident has revealed no damage to the structure and the accident can best be explained by a slip of the underlying material.

The pier caissons of the bridge are 60 x 136 ft. in plan and are divided by crosswalls, leaving 25 dredging wells. They are of structural steel and reinforced-concrete construction and, for purposes of flotation, were fitted with removable timber bottoms.

On June 7 the east caisson was landed on the bottom in 55 ft. of water. Since that time and prior to July 27 the concrete walls were carried up to an elevation of 79 ft. above the cutting edge and the false bottoms were removed from nine of the pockets. In the meantime the cutting edge sank 12 ft. below the river bottom. After the movement the east edge of the caisson was about 30 ft. below and the west edge 10 ft. above water.

Collateral Replaces Surety Bond On Subway Contract

Charging that surety bonding companies have denied bonds to subway contractors since the recent 50 per cent cut in premium rates ordered by Superintendent of Insurance James A. Behan was made, Chairman John H. Delaney of the Board of Transportation, of New York City, last week announced that Samuel Untermyer, special counsel for the Transit Commission, had agreed to assist in an investigation of the "surety bond ring," shortly to be conducted by the Board of Transportation, with a view to bringing their practices in respect to subway contracts out into the open. At the insistence of the transportation chairman, the estimate board passed a resolution permitting the Mason & Hanger Co., Inc., holder of one of the largest contracts for the new subways, to substitute $1,100,000 in municipal and government bonds for the $3,000,000 surety bond which it would ordinarily provide.

Moffat Tunnel Cost to Date Is $14,494,437

In the semi-annual report of the Moffat Tunnel Commission, the cost to date was placed at $14,494,437. Of the $18,000,000 received from the sale of bonds, there is cash on hand in the amount of $3,547,610 to be used to complete the construction of the railroad tunnel and approaches and to meet interest requirements. Expenditures for the six months ending July 7 totaled $2,908,406.

The total cost figure given in the semi-annual statement exceeds the estimated cost of $6,720,000 by approximately $7,750,000. This increased expenditure is the result of unexpected soft and hazardous ground, necessitating extra heavy timbering.

ENGINEERING TEACHERS AND STAFF ATTENDING WISCONSIN SUMMER COURSE

(Left to right) TOP ROW: A. Fick, S. B. Folk, P. T. Norton, M. O. Withey, H. L. Turrittin, E. Bennett, F. C. Hartwich, B. McLaurin, K. F. Wendt, A. S. Hansen. SECOND ROW: J. C. McKinnon, G. P. Stocker, F. H. Wade, H. E. Pulver, A. P. Poorman, C. H. Cather, E. Taylor, T. F. Waterman, H. E. Hartig, F. E. Pettengill, H. E. Mayrose, C. Merriman. THIRD ROW: R. D. Campbell, H. B. Wilcox, L. Tucker, W. B. Johns, W. E. Brooke, H. P. Boykin, L. M. Becker, D. M. Bayly, L. N. Field, C. S. Slichter, E. R. Maurer, E. M. Terry, F. G. Person, W. W. Wegner, C. A. Wiepking. BOTTOM ROW: S. M. Woodward, N. H. Winde, R. S. Tait, F. R. Stewart, M. K. Snyder, E. E. Moots, H. J. Kersten, L. F. VanHagan, F. E. Turneaure, B. Spieth, E. R. Dawley, C. F. Gross, J. H. Robert.

Engineering Officials Retained in Office in California

On July 29, B. B. Meek, an agriculturalist of Oroville, became director of public works of California under appointment from Governor Young. The present heads of the four major engineering departments are retained under temporary appointment as follows: Paul Bailey, state engineer; R. M. Morton, state highway engineer; Edward Hyatt, Jr., chief of the division of water rights and George McDougall, state architect. As a Colorado River commission the governor named W. B. Matthews, counsel for the Los Angeles Bureau of Water and Power; John L. Bacon, former mayor of San Diego and Earl C. Pond, president Imperial Irrigation District, Brawley.

"Excess Condemnation" to Provide Housing Plan for N. Y.

The Board of Estimate and Apportionment of New York City passed resolutions on July 28, endorsing Mayor Walker's plan for replacing the so-called slums of the city's congested districts by modern, multiple-family houses, using the "excess condemnation" method. This provision of the statute and city charter permits the city, when engaged in laying out, widening or extending streets, to acquire more land than is needed for actual construction, but sufficient for suitable building sites, and then to sell or lease the excess lands.

It is planned to condemn abuting properly suitable for building sites where streets are being widened in congested areas and then to lease it to private corporations for long terms on conditions governing the construction and renting of the homes to be constructed upon the property. Capitalists and philanthropists are eager to co-operate in this movement to better housing conditions and it has been indicated that modern apartments can be built with rentals as low as $8 per month per room.

Hereafter all street widening improvements projected and contemplated will be submitted to the board to determine whether or not such improvements shall be accompanied by excess condemnation proceedings.

Commission Not to Interfere With B. & O. Financing

The Interstate Commerce Commission has authorized the Baltimore & Ohio R.R. to issue $63,242,500 par amount of common capital stock to be sold according to a plan of financing prepared by the railroad company. Objection was raised to issuing such a large amount of stock and arranging for its underwriting without calling for competitive bids. The commission, in its decision, questioned the need for underwriting the issue but in view of the lack of definite assurance that so large an issue could have been sold otherwise ruled that it was a subject in which it should accept the judgment of the management of the railroad. In a concurring opinion, Commissioner Eastman indicated that he felt the time was not far distant when railroads would resort to competitive bidding for the sale of their securities as is now done with equipment trust certificates but that the time had not come for the commission to bring pressure on the railroads to that end.

Easy Runoff Relieves Colorado Delta Flood Danger

The flood that was expected on the lower Colorado River this summer as the result of an unusually heavy snow fall in the mountains last winter has so far failed to materialize. Spring and summer weather in the Colorado Basin has been such that the snow has melted off gradually and danger of a serious flood is now believed to be past. The following record of the runoff at Yuma in recent months gives this season's flow with relation to a 24-year average.

	Runoff in Acre-Feet	
Month	1927	Average for 24 Years
January	280,000	599,000
February	1,070,000	695,000
March	719,000	999,000
April	959,000	1,377,000
May	2,990,000	2,650,000
June	3,450,000	4,336,000
July	.....	2,508,000

Montreal to Spend $12,000,000 On Harbor Improvements

Final authorization has now been given for the expenditure of the $12,000,000 loan provided by the last Parliament for the improvement of the harbor of Montreal, according to advices received by the United States Department of Commerce. The new work will be started without delay in the following amounts: Dredging $800,000; wharves, piers and basins $5,400,000; plant and equipment $155,000; shops and buildings $322,000; rails and electrification $1,342,000; permanent sheds $300,000; grain elevators $3,155,000; miscellaneous $142,000.

STAFF AND MEMBERS, SUMMER CONFERENCE OF ENGINEERING TEACERS AT CORNELL

(Left to Right) UPPER ROW: G. H. MacCullough, A. P. Richmond, H. W. Merritt, H. W. Leet, E. V. Howell, F. T. Tingley, F. H. Evans, N. C. Riggs, J. A. Bullard, J. E. Mulligan, E. P. Slack, Eric Nygard. ROW 2 FROM TOP: J. H. Dyble, F. L. West, W. A. Gilmour, F. B. Schell, I. H. Prageman, F. E. Holmes, J. E. Lothers, W. D. Emerson, W. J. Conley, P. G. Laurson, J. B. Butler, J. B. Jones, K. G. Merriam. ROW 3 FROM TOP: H. A. Shaffer, F. N. Weaver, J. S. Lambie, F. J. Converse, A. H. Repscha, Andrew Simpson, R. C. Hudson, Z. R. Bliss, A. P. Powell, J. W. Breneman, S. D. Barclay, W. J. Cox, T. F. Hickerson. BOTTOM ROW: C. L. Walker, W. J. Risley, E. W. Rettger, C. F. Scott, D. S. Kimball, J. E. Boyd, R. M. Stewart, W. S. Franklin, H. P. Hammond, C. A. Wheeler.

At the M.I.T. sessions the following schools are represented: Worcester Polytechnic, Dartmouth, Cooper Union, University of Rochester, Cornell, Bucknell, Rochester Athenaeum and Mechanical Institute, Carnegie, U. S. Naval Academy, M.I.T., Brooklyn Polytechnic, Union, Case, Mount Allison, University of Akron, University of Pennsylvania, Iowa, Oklahoma A. and M., Norwich, Yale, Missouri Mines, Virginia Polytechnic, Tufts, University of Pittsburgh, California Tech, Drexel Institute, Swarthmore, Clarkson, Brown, Penn State, Pratt Institute, University of North Carolina, Colorado Mines, Ohio State and Connecticut Aggies.

Washington Notes

IN VIEW of the fact that funds may not be borrowed from other appropriations flood-control work on the Mississippi will be carried forward as rapidly as possible as long as the balance of the flood-control appropriation will last. This will leave the latter part of the fiscal year unprovided for, but it is believed that Congress will put through an emergency flood-control appropriation to take care of that situation as soon as it meets. Some of the levee boards on the lower river have been able to pay their part of the levee work and in view of the situation an intensive effort is being made on the part of other levee boards to raise at least a part of the local contribution required by the flood-control act. With these additional funds it is believed that work can be continued until December 1.

Preliminary data covering 275 possible reservoir sites in the Mississippi Valley were considered at a meeting of the Reservoir Board in Washington last week. While it would be entirely impracticable to use most of those sites for reservoir purposes, the board will include in its report a statement covering the situation at each possible site.

PUBLIC ownership advocates and those with interests in the vicinity of the Wilson Dam gave the War Department a difficult problem both fundamentally and physically, when they asked that power be sold to the municipality of Muscle Shoals. To figure the cost of a few hundred kw.-hr. involves a calculation of cost when one of the large generators is operated at 5 per cent capacity. No transforming facilities are available at the dam so it would be necessary to put all current through the transformers at the nitrate plant. Then there would be the difficulty of allocating costs between the Alabama Power Co., and the municipality. Also, the dam is under the direction of the Engineer Dept. while the nitrate plants are in charge of the Ordnance Dept. The Judge Advocate General has sent all papers back to the engineers for more details.

NO agreement has been reached between the United States and Mexico with regard to water for the new irrigation project under construction along the Rio Grande in Mexico near Matamoras. In fact, no official advice has been received of the appointment of members of the commission which is to study the international phases of the use of the water of the Rio Grande and Colorado River. The American members of the commission headed by Dr. Elwood Mead were named over a year ago.

THE Acting Secretary of War has renewed the lease to the Alabama Power Co. for a period of one year on the 1,000 kw. substation and other facilities and equipment connected therewith located at Waco Quarry near Russellville, Ala. He also has ratified renewal of the lease to the Alabama Power Co. for one year of the government owned electric railway and its appurtenances at the U. S. Nitrate Plant No. 2, Military Reservation, Muscle Shoals, Ala. Both leases are subject to cancellation by the Secretary of War on 30 days notice.

Plans Approved for $150,000,000 of Subways for Brooklyn

Plans to provide 25 miles of new subway lines at a cost of about $150,000,000 in the borough of Brooklyn, New York City, were approved July 28 by the Board of Estimate and Apportionment. Among the routes approved was one in Fulton St. construction of which may lead to the removal of the elevated line. The routes approved are as follows: Livingston St. route, from Court St. to Lafayette Ave.; Lafayette Ave. route, from Fulton St. to Marcy Ave.; Marcy Ave. and private property route, from Lafayette Ave. to Broadway; Union Avenue and McCarren Park route, from Broadway to Manhattan Ave.; Smith St. and Ninth St. route, from Union St. to Sixth Ave.; Prospect Park and Prospect Ave. route, from Prospect Park West to Terrace Place; Fort Hamilton Parkway and Gravesend Ave. route, from Greenwood Ave. to Avenue C; Fulton St. route, Lafayette Ave. to East New York.

The Fulton St. line will ultimately run into Jamaica and will cost approximately $52,800,000.

New N. Y. City Water Plan Would Cost $272,587,000

A NEW additional water supply plan for New York City consisting chiefly of the utilization of flood waters of Delaware River tributaries wholly within the state of New York, was submitted to the Board of Estimate and Apportionment on July 27 by the Board of Water Supply, city of New York, of which Thaddeus Merriman is chief engineer. In addition to 600 m.g.d. from the Delaware tributaries the project includes 100 m.g.d. from Rondout Creek, a tributary of the Hudson. It also provides for diverting about 100 m.g.d. from three of the existing high-level reservoirs of the Croton gathering grounds to the existing Kensico reservoir of the Catskill system. The estimated cost of the entire project is $272,587,000. This is $75,000,000 less than the plan for a 434-m.g.d. supply from streams east of the Hudson River, recommended by the Board of Water Supply last October (*Engineering News-Record*, Oct. 21, 1927, p. 670), abandonment of which is now advised. Details of the new project will be given in a later issue.

Brief News

WIDENING OF THE BUFFALO RIVER CHANNEL at the Ohio St. Bridge, Buffalo, N. Y., so as to eliminate the so-called bottle neck, is favored by the city planning committee and the city engineering bureau. This confirms the recommendation of the harbor improvement committee that this point which is the Huron Portland Cement Company's location should be taken by the city and widened as a navigation necessity. It was felt that with the natural increase in lake traffic and the competition that will result with the opening of the new Welland Canal, plans must be laid now for improved navigation facilities.

THE FIRST UNIT OF THE INCINERATOR system planned for Louisville, Ky., was placed in operation July 23. It has a capacity of approximately 100 tons of garbage daily and can be enlarged to burn 200 tons. It was built by the Henry Bickel Co. at a cost of approximately $160,000. Trains of trailers have been placed in operation collecting the garbage in the Highlands and Crescent Hill sections of the city.

TENDERS FOR BORING THE TUNNEL at the Bridge River power plant of the British Columbia Electric Railway Co. are to be called for at the end of August. The work will include construction of the surge chamber and the intake. The total length of the tunnel is to be 13,200 ft. and its diameter 13 ft. Preliminary work on the Bridge River project has been in progress for some time and the bunk houses, workshop and power plant are nearing completion.

THE WISE RIVER DAM of the Montana Power Co. in the southwestern part of Montana, which failed on June 14, was a small rock and earth filled structure with a plank facing forming a storage reservoir on a branch of the Big Hole River. Its failure was caused by unusually high water cut ing through the bank at one end of the dam, according to a report by the chief engineer of the power company. Operation of the Big Hole plant of the power company was discontinued some years ago and the reservoir had not been in active operation since that time.

RECOMMENDATIONS for buildings and other improvements needed to accommodate a corps of 1,200 cadets at the Military Academy at West Point, will be made by a board of 5 Army officers designated to study the situation, it has just been announced by the War Department.

A GIRDER BEING PLACED ON the new Canadian National Ry. bridge near Entrance, Alberta, on July 23, overturned the derrick. Four men were killed and two others injured as the derrick and girder dropped to the Athabasca River below.

Personal Notes

E. D. FRY, who has been a resident engineer associated with Solomon, Norcross & Keis, of Fort Lauderdale, Fla., is now acting as engineer of the Greater Greenville Sewer District Commission, at Greenville, S. C., in the construction, maintenance and operation of a sewerage system to serve a population of 75,000.

F. E. CUDWORTH, for the past three and one-half years superintendent for the Kenn-Well Contracting Co., on the East River Station, for the Brooklyn Edison Co., New York City, has resigned to accept a position as resident engineer on the new Hudson River Bridge, New Jersey section.

SIDNEY S. ANTHONY, Manchester, N. H., has been appointed superintendent of the Augusta, Me., Water District. Mr. Anthony is a graduate of Northeastern University, and has recently been employed on the construction of the Scituate Tunnel at Providence, R. I. He was also resident engineer at Ausable Forks, N. Y., on the construction of an earth dam. Later he was with the New Hampshire Power Co. in the construction of high power transmission lines.

VERNEY W. RUSSELL, Ellensburg, Wash., has been appointed Division Engineer in charge of construction of Division 3 of the main canal, Kittitas Division, Yakima Project, Bureau of Reclamation. Division headquarters are at South Cle Elum, Wash. Mr. Russell has been office engineer for field division fifty-three at the Ellensburg office of the Bureau of Reclamation.

FREDERICK T. MAVIS, Urbana, Ill., has been selected to receive one of the Freeman travel scholarships in hydraulic engineering, available through an endowment made by John R. Freeman, the scholarship providing a year's travel and study in Europe beginning with July, 1927. Mr. Mavis since last winter has been a research assistant at the University of Illinois and more recently has been assigned to studies of flood control in the Illinois and Mississippi River valleys. For the three years preceding, he was employed by Kelker, DeLeuw & Co., of Chicago.

H. L. RIDDLE, formerly senior resident engineer for the North Carolina State Highway Commission, has joined the engineering staff of the Tennessee Department of Public Works and is located at Jackson, Tenn.

E. W. EVERETT, former designing engineer, has been appointed assistant terminal engineer, Grand Central Terminal, New York City, for the New York Central Railroad Co.

PROF. HARRY E. BILGER, Springfield, Ill., has been appointed head of the engineering department and professor of civil engineering of Valparaiso University, Valparaiso, Ind. Mr. Bilger graduated from Bucknell University in 1903 and received a degree in civil engineering from the University of Missouri. He served as professor of structural engineering at Pei Yang University, Tientsin, China, and as professor of highway engineering at the Texas Agricultural and Mechanical College. More recently he has been bridge engineer and district engineer in the Illinois State Highway Department. He is the inventor and designer of a number of special collapsible steel forms for concrete work, particularly for culverts and highway work.

HOWARD MULLINS, formerly a resident engineer for the West Virginia State Highway Commission, is now located in Ames, Iowa, as a designer in the bridge department of the Iowa State Highway Department.

J. H. GUEST, city engineer, El Dorado, Ark., has left municipal work to enter the engineering department of the Missouri-Kansas-Texas Railway Co., and is located at Dallas, Texas.

C. M. CANNON, division engineer of maintenance-of-way at Arcadia, Fla., for the Seaboard Air Line, has been promoted to district engineer of maintenance-of-way at Arcadia, succeeding J. W. SEXTON who has been made assistant trainmaster of the North Carolina division with headquarters at Hamlet. G. C. RUSKELL is appointed division engineer of the South Florida division with headquarters at Arcadia, succeeding Mr. Cannon.

HAWLEY S. SIMPSON, as traffic engineer of Essex County, New Jersey, is engaged in a survey of traffic conditions in the county. Mr. Simpson was for some time traffic engineer of the Mayor's Traffic Committee, Police Department, Detroit, Mich., and formerly, after graduation from the University of Michigan, was engaged in municipal work with Verner, Wilhelm & Molby, Detroit.

M. STEINMETZ has resigned as general superintendent of water-works construction for the Standard Paving Co. to accept a position with the National Cement Co., of Alabama and Georgia, as chief engineer and operating manager with his headquarters at Birmingham, Ala.

ROBERT W. CHAFFEE, civilian engineer in the office of the division engineers, U. S. Engineers Department, Army Building, New York, is to be transferred Aug. 1 to duty in the office of the Chief of Engineers at Washington, D. C.

P. F. HOPKINS, city manager since 1920 at Ames, Iowa, became the first city manager of Mason City, Iowa, on June 1. Mr. Hopkins is a graduate of Iowa State College, and in the past has been connected with the engineering department of that school, the University of Wisconsin, the Iowa State Highway Commission, and during the war was on construction work at Nitro, W. Va., later being chief engineer of water, sewers and gas during operations of the government powder plant there.

F. W. HARTMANN has resigned as city engineer at Iron Mountain, Mich., and has accepted the position of city manager of Alma, Mich. He is a graduate of the University of Michigan, civil engineering department, and prior to employment by the city of Iron Mountain was with Hoad, Decker, Shoecraft & Drury, consulting engineers, Ann Arbor, as engineer on the design and construction of water purification and sewage disposal plants.

J. W. WILLIAMS, who has been consulting engineer in the city attorney's office in San Diego, Calif., has been made assistant manager of operations and placed in charge of water development.

R. H. WILSON, former district highway engineer at Seattle, and F. W. Panhorst, chief field assistant bridge engineer, have joined the California State Highway Department.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Meeting, Boston, Mass., Sept. 13-16, 1927.

AMERICAN WELDING SOCIETY, New York City; Fall Meeting, Detroit, Mich., Sept. 19-23, 1927.

ASPHALT PAVING CONFERENCE: Under the auspices of the Asphalt Association and Association of Asphalt Paving Technologists; annual conference Atlanta, Ga., Nov. 28-Dec. 2, 1927.

THE CENTRAL STATES SECTION of the American Water Works Association will hold its annual meeting at Akron, Ohio, Sept. 15 and 16, 1927. E. E. Bankson, Union Bank Building, Pittsburgh, Pa., is secretary.

THE SAN DIEGO (CALIF.) CHAPTER, American Association of Engineers, has elected officers as follows: President, Tom J. Allen; vice-president, Tom H. Messner; treasurer, John L. Carter; corresponding secretary, Richard V. Dodge, Jr.; recording secretary, E. P. Chilton.

THE PROVIDENCE, R. I., ENGINEERING SOCIETY enjoyed a midsummer engineering tour recently, leaving Providence Thursday evening, July 14, by steamer, arriving in New York Friday morning, spending the day visiting the Edison Lighting Institute at Harrison, N. J., sailing from New York Friday night, and arriving home in Providence Saturday morning, July 16.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer Is Doing for the Engineer and Contractor

Construction Exhibit Planned for A. G. C. Meeting in January

The Associated General Contractors are planning to hold a national construction exposition in the West Baden Springs Hotel, West Baden, Ind., January 23-27, 1928, according to Gen. R. C. Marshall, Jr., of Washington, general manager of the association. The exhibits will be planned to demonstrate all types of construction material, supplies and accessories. Awards will be made by a committee of the A.G.C. to the companies having displays adjudged the most effective. The exposition will be held in conjunction with the ninth annual meeting of the association.

Cement Imports Fall Off

According to preliminary figures of the Department of Commerce, 99,969 barrels of cement, valued at $201,682 were imported during June, 1927, a quantitative decrease of 70 per cent compared with June, 1926, when 335,570 barrels valued at $495,744 were imported.

Belgium furnished 78,618 barrels (72 per cent of the total) valued at $163,845 during June, 1927, and in 1926 235,212 barrels (70 per cent of the total) valued at $374,117.

Imports of cement for the first six months of 1927 totaled 975,507 barrels valued at $1,810,422 compared with imports of 1,983,941 barrels valued at $3,148,522 for the same period of 1926.

During the first six months of 1927 the United States exported 415,626 barrels valued at $1,414,910; for the same period of 1926 American exports of cement amounted to 471,575 barrels valued at $1,400,735.

Business Notes

INGERSOLL-RAND CO., New York City, has opened a branch office at 236 High Street, Newark, N. J., in charge of F. K. Armstrong in order to provide better sales and service facilities for its customers in northern New Jersey and the adjacent counties in New York.

HURON PORTLAND CEMENT CO., Detroit, Mich., has added another bulk freighter to its fleet of cement carriers on the Great Lakes. The new vessel, the "S. T. Crapo" is said to be the largest, most modern self-unloading bulk cement carrier on the Great Lakes. Its equipment enables it to unload a bulk cargo equivalent to 160,000 sacks of cement in 10 hours without the aid of any dock equipment. A full cargo can be taken on in four hours. The boat is 400 ft. long with a hold depth of 29 ft. and a beam of 60 ft. It is powered by three 2,000 hp. Scotch marine boilers and a triple expansion engine giving a speed of 13 m.p.h.

NATIONAL CAST IRON PIPE CO., Birmingham, Ala., announces the opening of an eastern and export office at 225 Broadway, New York City, in charge of O. A. Nelson.

C. O. BARTLETT & SNOW CO.'s Pittsburgh office has been placed in charge of W. C. Schade.

DAYTON-DOWD CO., Quincy, Ill., announces the appointment of E. G. Dewald, Salt Lake City, as its representative in that district.

BYERS MACHINE CO., Ravenna, Ohio, announces that arrangements have been made by which Smith Booth Usher Co., Los Angeles and San Francisco, will handle the sale of Byers Bear Cats in the territory served by these two offices. E. L. Kelzer, Pacific Coast district manager for Byers Machine Co., will continue to co-operate with Byers agents on the Pacific Coast.

CHICAGO CHEMICAL CO., of Chicago, announces the appointment of Dr. G. J. Fink as head of its new research department. Dr. Fink, formerly chemical director of the National Lime Association, Washington, D. C., will be occupied largely with developing new products and extending the use of the present products of the company.

NATIONAL PAVING BRICK MANUFACTURERS ASSOCIATION announces that Miss E. L. Beller was recently elected secretary of the association. Prior to her recent appointment she served the association as assistant treasurer, which office she now retains in addition to the secretaryship. Miss Beller is president of the Women's Advertising Club of Cleveland, Ohio.

ASH GROVE LIME AND PORTLAND CEMENT CO., Kansas City, Missouri, has announced plans for a large, modern Portland Cement plant at Louisville, Nebraska, twenty miles southwest of Omaha. The plant will have an initial production of ¾ million barrels, and an ultimate capacity of one and one-half million barrels annually. The estimated cost is $2,000,000 when completed. It will be ready for operation within 12 or 15 months. It is said that sufficient raw material can be quarried in the vicinity of the plant for one hundred years of capacity operation. The Ash Grove Co. at present operates lime plants at Ash Grove and Galloway, Missouri, and a Portland cement mill at Chanute, Kansas.

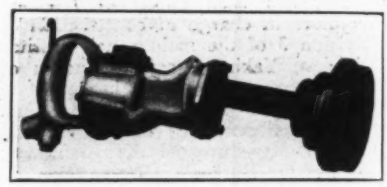
WHITE CO., Cleveland, has awarded a contract to the Aberthaw Co., Boston, for the construction of the first unit of its new motor truck branch service and sales building, Providence, R. I. The building will be a one and two-story structure of reinforced concrete, brick and steel construction and approximately 102 ft. x 200 ft. in plan.

New Developments

Air Tool Finishes Surfaces of Concrete Walls and Bridges

A portable concrete surfacing machine, operated by compressed air, has been developed by Ingersoll-Rand Co., New York City. The machine is claimed to quickly and easily smooth concrete surfaces and remove form marks either on green or old concrete. In addition it is claimed to give a much better job than hand rubbing.

The machine is equipped with a ring-shaped grinding wheel which utilizes the



flat face of the wheel. The grinding wheel is held by a wheel head, the latter incorporating a flexible joint. This flexible coupling is a special feature of the tool and insures true action of the wheel on the surface being finished. The wheels are easily renewed when worn down by use.

A three-cylinder type of air motor is used in the machine. All wearing parts, including the cylinders, are renewable. The tool weighs 13 lb. Special grinding tools are available when the machine is to be used for finishing and polishing monumental and building stone.

New Line of Oil-Jacks Covers Range of 1½ to 60 Tons

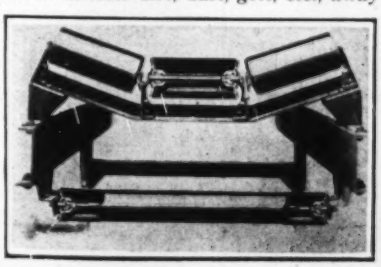
Designed both for automotive and construction uses, a new line of hydraulic oil-power jacks has recently been introduced by the Blackhawk Manufacturing Co., Milwaukee, Wis., carrying ten various models in nine different capacities. The antomotive model embraces both single and double lift models, including low and high built jacks from 1½ to 18 tons capacity. The construction and industrial models range from 18 to 60 tons capacity.

Under another name these hydraulic oil-power jacks have been made and distributed for the past five years on the Pacific Coast. One of the jack's special features is a twin-check valve located below the pump in an especially accessible position. Ease of operation is another feature of the jacks. Short strokes raise the ram and lowering is done automatically with a controlled release valve. Horizontal use of the jack, such as shown in one of the accompanying illustrations, is practical, provided the jack is operated with the pump side down. This illustration shows 30-ton Blackhawk jacks being used by the California Highway Commission for moving a four-span bridge,

weighing nearly 3,000 tons. The bridge was raised 10 in., loaded on rails and skidded 13 ft. in 12 hours. The other illustration shows an 18-ton model which is 14 in. high when lowered, has an 8¼-in. lift and weighs 60 lbs.

Unusually Efficient Lubrication For Belt Conveyor Idler

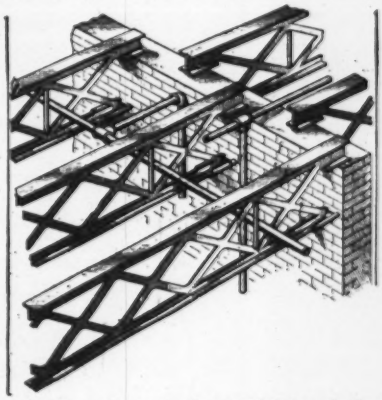
Announcement is made by the Link-Belt Co., Chicago, of the introduction of a new anti-friction belt conveyor idler and return rolls of an advanced type for belt conveyor equipment. The outstanding feature of the idler is the unusual protection afforded by a grease seal mounted in a grease cup, which also serves as an outboard reservoir, lubricating the bearing on the outside as well as on the inside. This grease cup is in turn protected by a plate which deflects dirt, dust, grit, etc., away from the bearings and grease seal and will not permit the washing of the grease away from the seal. Timken tapered roller bearings are used totally encased within the roll hub.



All rolls are interchangeable, being capable of serving in any of the three positions. The entire frame is riveted. Unusually close working tolerances are used, and special care is exercised in machining the roll shell. The rolls are spaced far enough apart to permit convenient removal from the frame by simply lifting them out without the use of any tools. The rolls are made in various standard lengths and are furnished in combinations to suit standard belt widths. In the illustration the center roll and the return idler are cut showing the interior construction.

Truss Joists Made by Expanding Solid Web I-Beam Sections

A truss joist has recently been placed on the market by the Bates Expanded Steel Truss Co., East Chicago, Ind., which uses no joint rivets or welds; the joist is expanded from a solid web I-section after the web has been sheared or slitted with interrupted cuts running lengthwise of the section. For the expanding process the beam is uniformly heated, and placed in an expanding machine which grips the flanges of the I-beams throughout their entire length. The act of expanding increases the depth of the beam and creates from the split web a truss web of



one piece of steel of open lattice design as shown in the accompanying drawing.

The truss joist lends itself to all types of construction and the open web is an advantage because it permits piping to be run easily in any direction. The joists are available in depths from 8 to 16 in. and in lengths from 6 to 35 ft.

New Portable Compressor Built in Three Sizes

To its complete line of pneumatic tools, the Denver Rock Drill Mfg. Co., Denver, Colo., announces the addition of a new portable gasoline engine driven air compressor. The new compressor is made in three sizes, 6x4½ in., 6x6 in., and 9½x6 in. bore and stroke, providing a selection suitable for the operation of a varying number of rock drills, concrete breakers, clay diggers, air hoists, sheeting drivers, etc.

A four-cylinder, L-head type engine with forced feed lubrication is used, equipped with a high tension magneto and impulse starter to insure easy starting.

The engine drives a single acting, duplex, vertical compressor, through a flexible coupling. The compressor is water jacketed, uses a balanced crankshaft and is equipped with suction and discharge valves of the Duo-plate type, which operates with a low lift, said to insure efficient operation.

The frame is a single piece steel casting, with air receiver and gasoline tank mounted on an extension at the rear. These compressors may also be skid mounted, rubber tire mounted, or trailer mounted.

Manufacturers and Trade Associations

Calendar

Annual Meetings

NATIONAL HARDWOOD LUMBER ASSOCIATION, Chicago; Annual Convention, Chicago, Sept. 15-16.

CONCRETE REINFORCING STEEL INSTITUTE, Chicago; Semi-annual meeting, Aviation Country Club, Detroit, Sept. 19-21.

AMERICAN PAINT & VARNISH MANUFACTURERS ASSOCIATION, Philadelphia; Annual Convention, Atlantic City, Oct. 24-25.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, New York; Annual convention, Pinehurst, N. C., Oct. 25-29.

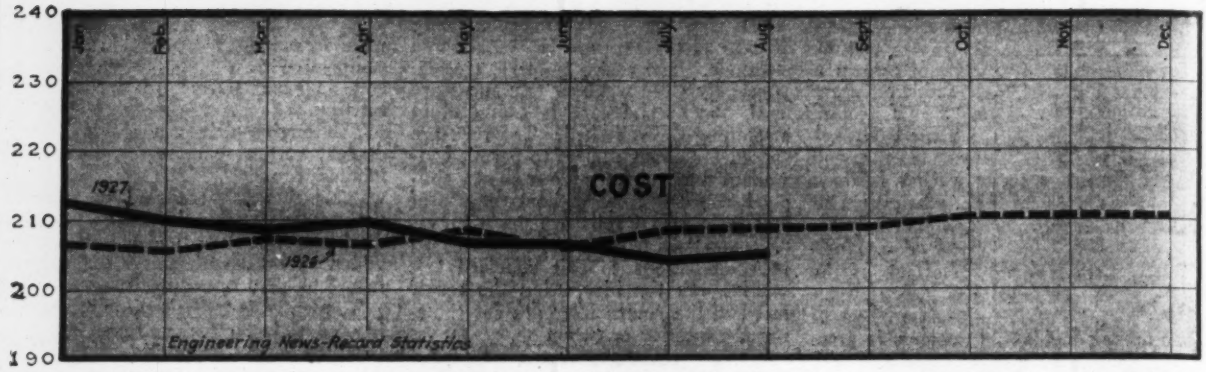
NATIONAL ASSOCIATION OF MANUFACTURERS; Annual meeting, Chattanooga, Tenn., October 25, 26 and 27.

New Publications

Blueprint Equipment—C. F. Pease Co., Chicago, has issued a new catalog M-27 describing and illustrating its various types of blueprinting machinery and drafting room furniture. Materials such as blueprint paper, transparentizing solution, paste and other accessories are illustrated and described.

Welding and Cutting Equipment—International Oxygen Co., Newark, N. J., has published a new catalog No. 27 describing and illustrating its welding and cutting equipment consisting of torches, gages, regulators, regulator adapters, piping systems, acetylene generators, gas cylinders, tubing, etc. At the back of the catalog is given a page and a half of information and rules on the safe handling and use of compressed gas facilities.

Engineering News-Record Statistics of the Construction Industry



Engineering News-Record CONSTRUCTION COST Index Number (1913 = 100)

MONTHLY

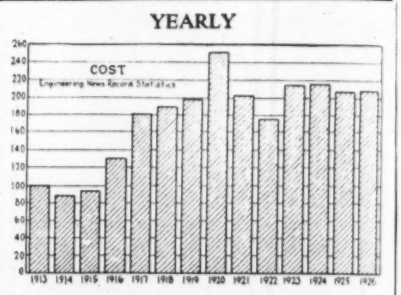
August, 1927	205.50
July, 1927	203.68
August, 1926	208.30
Peak, June, 1920	273.80
1913	100.00

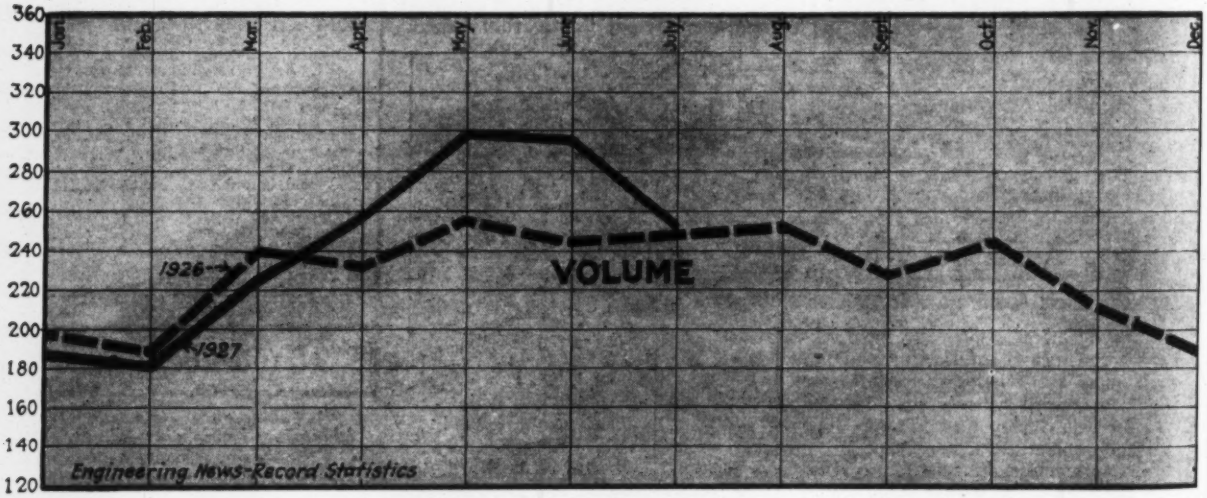
1927

Jan....211.50	Mar....208.80	May...206.80
Feb....210.15	April...209.00	June...205.55

Engineering News-Record's Construction Cost Index Number is 0.8 per cent above July, 1927. The increase is due mainly to stronger markets in certain of the structural materials. The average rate for common laborers remains at the July level of 55½c. per hr.; the same rate prevailed at this time last year. Thus, general construction cost is 1.3 per cent below August, 1926, 25 per cent under the peak and 105 per cent above 1913.

YEARLY





Engineering News-Record CONSTRUCTION VOLUME *Index Number (1913 = 100)*

MONTHLY

January, 1926, to July, 1927

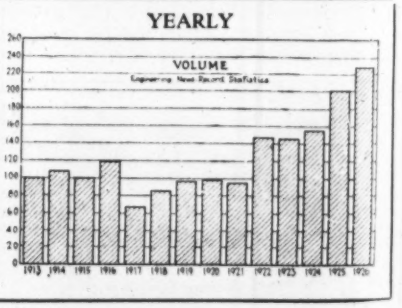
July, 1927	252
June, 1927	297
July, 1926	248
May, 1927	299
1913	100

1927

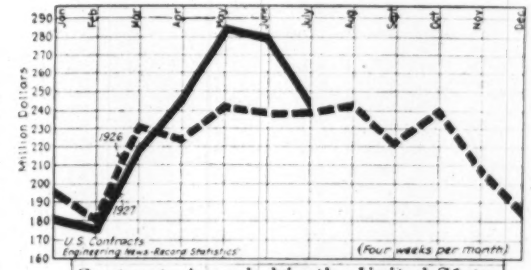
Jan.....187	Mar.....226	May.....299
Feb.....182	April.....257	

Engineering News-Record's Construction Volume Index Number is 252 for the month of July and 228 for the whole of 1926, as against 100 for 1913. This means that the actual volume of contract letting in 1926 (not the mere money-value of the contracts let that year) is 128 per cent above the volume for 1913. The monthly volume number, 252 for July, 1927, contains the increment of construction and indicates the rate at which contracts are being let as compared with 1913 awards.

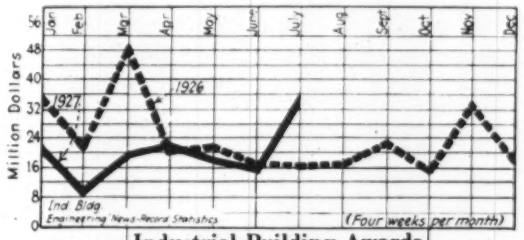
YEARLY



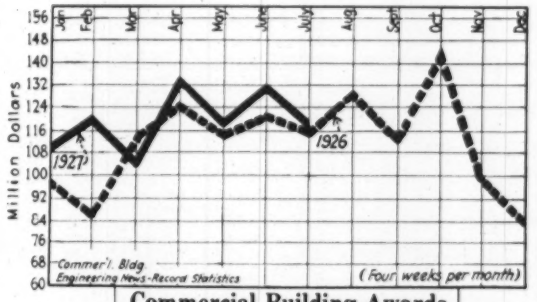
Monthly Statistics of the Construction Industry



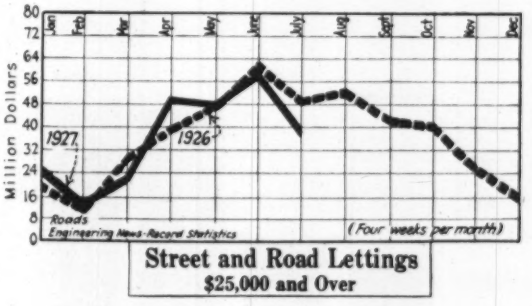
Contracts Awarded in the United States
Reported by E. N.-R.



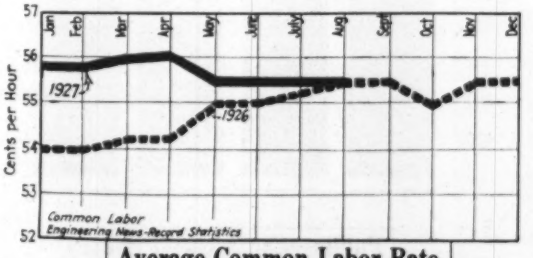
Industrial Building Awards
$40,000 and Over



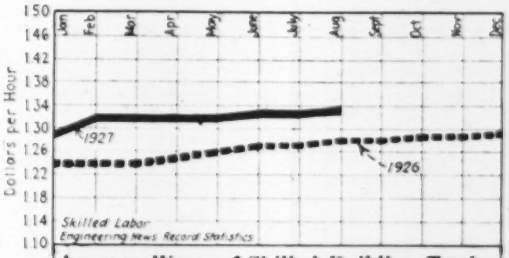
Commercial Building Awards
$150,000 and Over



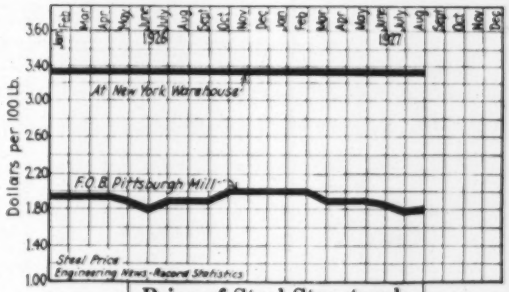
Street and Road Lettings
$25,000 and Over



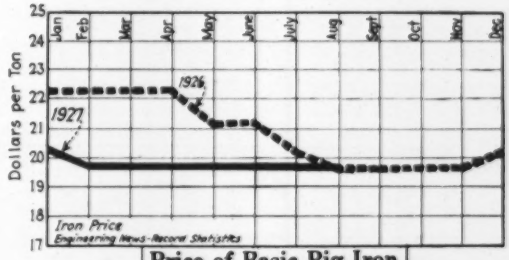
Average Common Labor Rate
Pick and Shovel Men



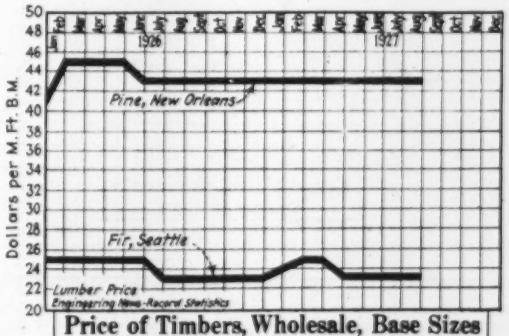
Average Wage of Skilled Building Trades
Bricklayers, Carpenters and Steel Erectors



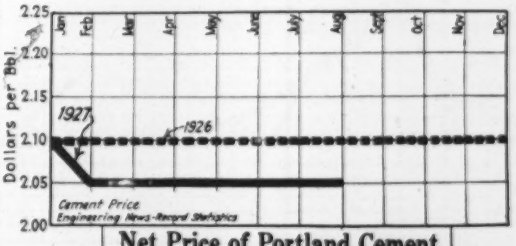
Price of Steel Structurals
Shapes 3-in; Plates ¼-in.



Price of Basic Pig Iron
F.o.b. Pittsburgh

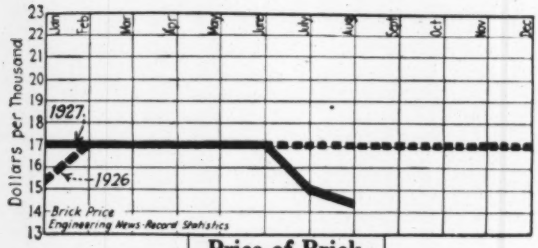


Price of Timbers, Wholesale, Base Sizes
Car Lots to Contractors

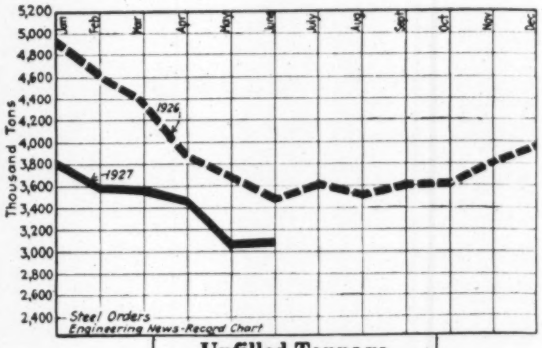


Net Price of Portland Cement
Car Lots F.o.b. Chicago

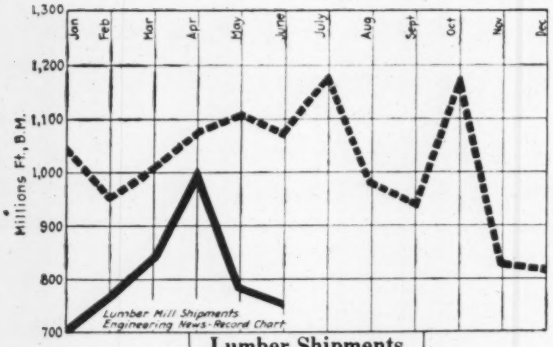
Monthly Statistics of the Construction Industry



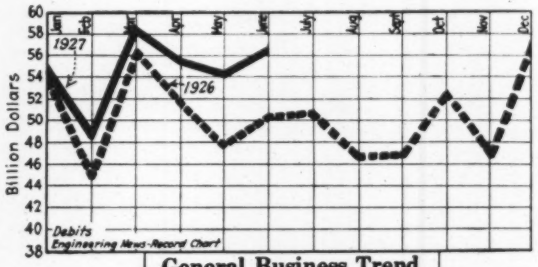
Price of Brick
At Dock, New York



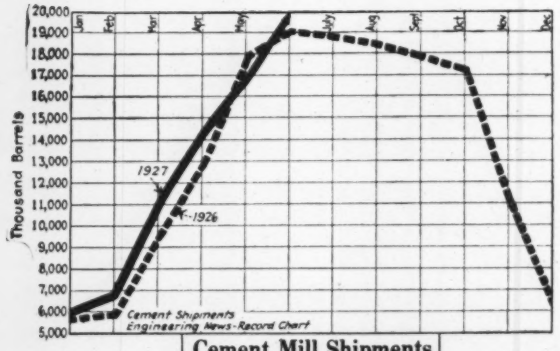
Unfilled Tonnage
On Books of U. S. Steel Corp.



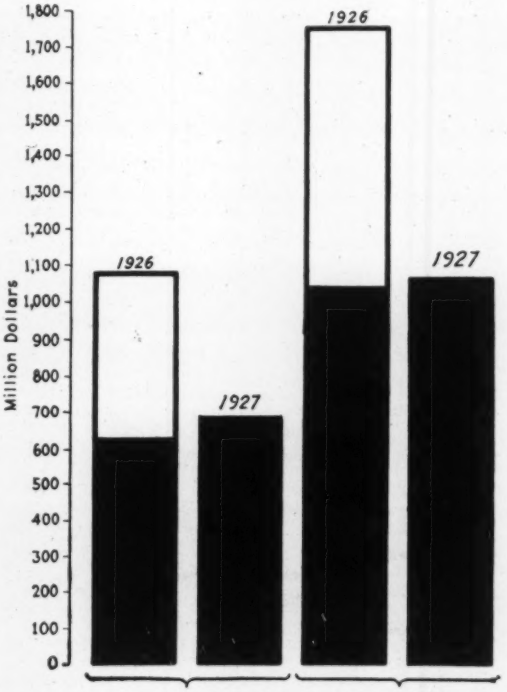
Lumber Shipments
Nat. Lumber Mfrs. Assn.



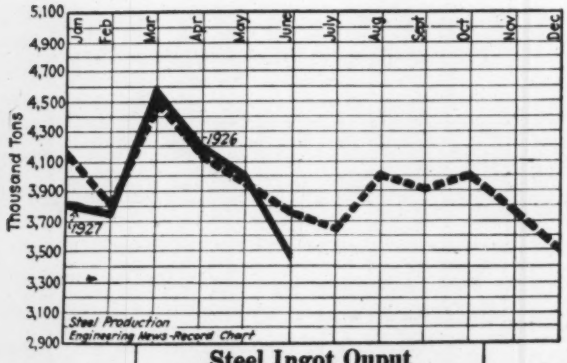
General Business Trend
Bank Debits—Federal Reserve



Cement Mill Shipments
Bureau of Mines



Public—Contracts—Private
Jan. 1 to date
Reported by E. N.-R.

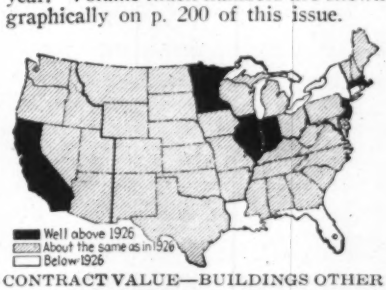


Steel Ingot Ouput
Gross Tons; Am. Iron and Steel Inst.

This Year to Date Ahead of Last in Value of Contracts

Projected Work In Slightly Smaller Volume

VOLUME of July contract letting in the heavy construction field, reached a point 34 per cent above the average for that month during the last six years, according to figures based on reports published in the Construction News Section of *Engineering News-Record*. This is not considering the situation from the standpoint of actual money value of contracts let, but rather upon a basis of materials and labor costs as they were in 1913, the last pre-war year. Volume index numbers are shown graphically on p. 200 of this issue.



CONTRACT VALUE—BUILDINGS OTHER THAN INDUSTRIAL OR SMALL RESIDENTIAL FOR FIRST TWENTY-ONE WEEKS OF 1927

Contract values in the accompanying table are based on a minimum for each class, as follows: waterworks, excavation, drainage, irrigation, levee, river and harbor projects, $15,000; other public works, $25,000; industrial buildings, $40,000; commercial, educational, institutional, religious and other buildings, $150,000. These figures are for the entire United States.

Difference in costs between the July and August markets, as explained on p. 200, does not amount to even one per cent, while the current level is a fraction over one per cent below that of August, 1926.

A comparison of contract totals, all classes taken together, for the country as a whole, and on a weekly basis, follows:

July, 1927	$60,162,500
June, 1927	70,485,600
July, 1926	59,819,800

The cumulative total, all classes, at minimum mentioned, is $1,755,629,000 for the entire U. S., Jan. 1 to Aug. 1, 1927, against $1,659,106,000 for the corresponding period last year. This increase in money invested in a market where costs are even slightly lower, may, if continued throughout the remaining five months, place 1927 ahead of any other year on record, in heavy construction operations.

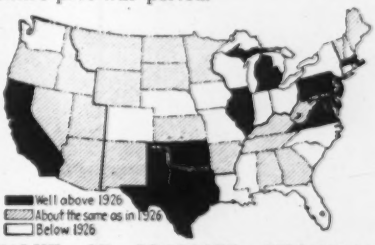
Projected work, definitely reported as proposed, does not show the favorable picture presented by contract values.

Comparison of proposed work on a weekly basis, all classes, entire U. S., at minimums stated, follows:

July, 1927	$71,735,250
June, 1927	91,232,000
July, 1926	80,374,200

Between Jan. 1 and Aug. 1, 1927, projected work reached a cumulative total of $3,194,398,000, compared with $3,363,737,000 for the corresponding period last year. This difference of 5 per cent has strong possibilities of being evened up during the last half of the current year.

Thus far this year, marked gains have been made in construction of sewers, bridges, commercial and public buildings and also in excavating projects. The decrease has been slight in water-works, streets, roads and Federal Government construction. The decline in industrial building, though heavy, is not unexpected, since the nation's mill capacity has been in excess of demand during the entire post-war period.



VALUE OF PROPOSED BUILDING: OTHER THAN INDUSTRIAL OR SMALL RESIDENTIAL FOR FIRST TWENTY-ONE WEEKS OF 1927

Notable increases were made in money value of awards during the last month, in the South and Far West, especially in Virginia, Florida, Alabama, Mississippi, Louisiana, Tennessee, Texas, Colorado, New Mexico, Utah, Washington, Oregon and California. Rhode Island was the only Eastern and Iowa the sole Mid-western state to show exceptional gains in contract letting.

Value of Contracts Awarded by Sections—July, 1927

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States	Jan. 1 to date, U. S.	Canada
Waterworks	$59,000	$390,000	$294,000	$369,000	$1,108,000	$289,000	$2,509,000	$33,313,000	.....
Sewers	130,000	2,530,000	87,000	4,209,000	633,000	599,000	8,188,000	63,262,000	$149,000
Bridges	414,000	614,000	2,180,000	1,499,000	1,102,000	218,000	6,027,000	72,038,000	64,000
Excavations, drainage, etc.	107,000	752,000	824,000	.....	222,000	15,000	1,920,000	31,566,000	50,000
Streets and roads	1,847,000	9,454,000	6,863,000	7,547,000	8,487,000	5,021,000	39,219,000	282,299,000	916,000
Industrial Bldgs.	1,231,000	2,468,000	7,565,000	9,611,000	3,882,000	10,420,000	35,177,000	152,352,000	650,000
Commercial Bldgs.	17,650,000	59,582,000	2,293,000	18,346,000	6,193,000	13,499,000	117,563,000	895,305,000	3,950,000
Federal Government	3,000	1,672,000	1,136,000	1,209,000	287,000	1,337,000	5,644,000	28,305,000	.....
Unclassified	566,000	650,000	748,000	1,016,000	20,133,000	1,310,000	24,403,000	197,279,000	90,000
July, 1927	$22,007,000	$78,092,000	$21,990,000	$43,806,000	$42,047,000	$32,708,000	$240,650,000	$1,755,629,000	$5,849,000
June, 1927	33,534,000	130,474,000	19,731,000	81,119,000	60,817,000	26,753,000	352,428,000	.....	19,747,000
July, 1926	33,994,000	63,483,000	25,964,000	94,285,000	59,613,000	21,760,000	299,099,000	.....	16,477,000
Jan. 1 to date, 1927	147,079,000	541,210,000	125,461,000	422,835,000	310,784,000	213,280,000	1,755,629,000	.....	63,188,000
Jan. 1 to date, 1926	137,193,000	516,319,000	182,504,000	404,762,000	250,709,000	167,619,000	1,659,106,000	.....	79,398,000

Labor Rates and Conditions Throughout the Country

Most Of Present Troubles Do Not Involve Wage Demands

STRIKES, walk-outs, and other labor controversies which developed during the last month, have had the effect of offsetting agreements reached at the same time, in other sections of the country.

Supply of building workers in excess of demand, persists in Dallas, Birmingham, Boston, and Philadelphia. In the first city mentioned, the surplus is confined to pile drivers, in the second and third, to common laborers, and in the last, to carpenters, plumbers, painters, and cement finishers.

Building continues slow in San Francisco with very few signs of improvement, while in the Detroit district, there is a noticeable tendency to accept lower wage rates in the construction trades.

Montreal is experiencing a shortage of bricklayers and ironworkers; many in the latter trade are coming to the United States, where higher rates are paid this craft.

Labor Disputes of Last Month

New York, N. Y.—Walkout of members of Operative Plasterers and Cement Finishers' Union and the Bricklayers, Masons and Plasterers' International Union is declared in violation of the arbitrament recently granted by Elihu Root. The present trouble hinges upon a breach of agreement to interchange cards held by cement finishers who belong to the plasterers' union and those of the same craft who are members of the bricklayers' union. The Electrical Board of Trade has announced its intentions of not renewing the agreement with the Electrical Workers' Local No. 3, which expires Dec. 31, 1927. Differ-

Current Building Trades Wage Rates Per Hour

(Higher rates than a month ago indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.40	$0.70	$0.70	$0.50	.....	$0.75	$0.25@.30
Baltimore	1.62½@1.75	1.00@1.10	1.00@1.37½	1.00	$0.65	1.00@1.25	.40
Birmingham	1.00@1.50	1.05	1.00	.50@.75	.....	1.75	.25@.40
Boston	1.40	1.25	1.25	.79	1.15	1.25	.45@.74
Cincinnati	1.50	1.35	1.35	.97½	1.35	1.35	.45@.60
Chicago	1.62½	1.10@1.50	1.00@1.50	.90@.96¼	1.50	1.50	.90
Cleveland	+1.62½	1.37½	1.30	.87½	1.10	1.50	.87½
Dallas	1.62½	1.12½	1.00	.40@.75	1.00	1.25	.30@.50
Denver	1.50@1.62½	1.25	1.25@1.37½	.87½@1.00	.....	1.25	.31¼@.50
Detroit	1.56¼	1.00@1.25	1.00@1.10	.90	1.00@1.10	1.00@1.25	.50@.60
Kansas City, Mo	1.50	1.25	1.25	.90	1.25	1.25	.35@.75
Los Angeles	1.37½	1.00	1.00	.87½	1.00	1.00	.50
Minneapolis	1.25	.87½@95	.87½	.75	....	1.00	.45@.60
Montreal	1.25	.75	.75	.40	.50	.85@.90	.30@.35
New Orleans	1.50	.90	+1.25	.75	+.80@1.00	1.25	.30@.40
New York	1.75	1.50	1.75	1.12½	1.00@1.12½	1.75	.90⅝
Philadelphia	1.62½	1.12½@1.25	1.02½	.70@1.12½	1.00	1.37½@1.50	.45@.50
Pittsburgh	1.70	1.50	1.37½@1.50	1.12½	....	1.50	—.50@.80
St. Louis	1.75	1.50	1.50@1.65	1.15@1.25	1.25	1.50	.40@.75
San Francisco	1.37½	1.12½	1.00@1.12½	.87½	1.12½	1.37½	.50@.60
Seattle	1.37½	1.12½	1.00@1.12½	1.00	1.00@1.12½	1.12½@1.25	+.62½@.70

ences existing between the international body and the local, prompted the Board to take this action.

Newark, N. J.—Electricians and ironworkers on strike at $10,000,000 Bamberger store addition; hoisting engineers may also become involved. Signalling of derrick men constitutes the crucial point in the situation.

Asbury Park, N. J.—Hod carriers rated at $7 per day, are on strike, demanding advance of $1. Five other building trades began a sympathy strike July 25.

Providence, R. I.—Building trades moving toward a sympathetic action to force settlement of laborers' and helpers' strike, which has been in effect about a month. Carpenters strike for wage advance of 15c. over present rate of $1.10 per hr., partially settled.

Rochester, N. Y.—Carpenters, elevator constructors and lathers on strike in protest against open shop.

SETTLEMENTS DURING MONTH

St. Louis, Mo.—Union electricians will adopt the 5-day week system, beginning Sept. 1. Wage scale will remain at $1.50 per hr. for journeymen. This ruling will affect 700 electricians, of which number, about 100 are at present unemployed.

Madison Co., Ill.—Painters and decorators signed up at old wage rate, with 5-day week.

Baltimore, Md.—Jurisdictional dispute between bricklayers and plasterers over placing of imitation marble, ended July 22 by return to work of many of the participants.

Cleveland, O.—Bricklayers granted advance of 12½c. per hr. from $1.50, retroactive to July 1.

Oklahoma City, Okla.—Injunction obtained by thirteen electrical contractors against local union, dismissed in district court.

Portland, Ore.—Painters signed up at rate of $8.40 per day and 5-day week, effective until Oct. 1, 1928.

Monthly Prices of Construction Materials

DEMAND for construction materials and labor, as indicated by money value of contracts let for the first seven months of 1927, is nearly 6 per cent ahead of the corresponding period last year. This is shown to be a real gain, in that costs are between 1 and 2 per cent below those effective at this time in 1926.

Several groups of materials appear to approach stability, especially since present steadiness of prices can in no way be attributed to a stagnant construction market, regardless of the apparent drop in speculative building. In this category are the following: sand, gravel, crushed stone, crushed slag, railway ties, steel pipe, road oils, paving stone, flagging, curbing, and glass.

In this comparison, prices of materials are taken for the twenty-one great industrial districts mentioned in the accompanying table of current building trades wage rates.

Taken together, these cities show a net gain in prices of cement, structural rivets, nails, spikes, lime, explosives, and scrap.

The three principal hot-rolled steel materials hold with decided firmness to a price of $1.80 per 100 lb., f.o.b., Pittsburgh. This quotation covers base sizes, namely, concrete reinforcing bars, ¼-in. and larger; beams and channels, 3 to 15-in.; angles, 3 to 16-in.; tees, 3-in. and larger; and plates, ¼-in. thick and heavier. Leading makers of this material in the Pittsburgh district do not recognize any quotations below the $1.80 price in the current market. Moderate tonnages down to a few carloads, however, are being sold at the figure mentioned.

One of the incongruities of the present market for basic materials is the case of pig-iron. The latter is now at a price 17 per cent below levels of 1922, while finished steel products are approximately 3 per cent above quotations as of that time.

A rate of production and a volume of reserve stocks slightly in excess of current demand, are the only visible causes of the present downward trend in the following: light and re-rolled rails; track supplies; cast-iron pipe; clay products—hollow tile, drain tile, sewer pipe and common brick; wood paving blocks; asphalt; steel sheets; linseed oil; copper sulphate; and lumber. In the last mentioned material the general downward trend is mostly in pine and fir boards, planks and timbers; hemlock and spruce remain unaffected.

The cement situation shows considerable improvement over that of a month ago, especially in Boston. In the district mentioned, the July price dropped 15c. per bbl. from the month preceding, accompanied by indications of further decline. It is evident that heavy importations of Belgian, British and Norwegian cement were responsible for the collapse of the market. One sign of improvement in the situation at Boston, from the manufacturers viewpoint, is the advance of 5c. per bbl. in the August price, compared with that of a month ago.

Brick prices dropped during the month at New York, Denver, Boston, Kansas City, Mo., and New Orleans, as shown in the table following. Imports together with used brick from demolition operations, contributed to the repletion in the New York market. Denver, with a reserve of approximately 5,000,000 bricks, sustained a badly broken market with prices unsteady in this particular material.

E. N.-R. Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton f.o.b.:

	Aug. 4	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25@2.75)	$22.19	$24.69
Northern Basic	20.89	20.39
No. 2 Southern Ohio (silicon 1.75@2.25)	21.19	21.39
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25@2.75)	26.37	27.37
BIRMINGHAM		
No. 2 Foundry (silicon 2.25@2.75)	*17.25*	21.00
PHILADELPHIA		
Eastern Pa., No. 2X (2.25@2.75 sil.)	22.76	22.76
Virginia No. 2 (silicon 2.25@2.75)	27.17	28.67
Basic	21.76	21.26
CHICAGO		
No. 2 Foundry Local (silicon 1.75@2.25)	21.00	21.00
No. 2 Foundry Southern (silicon 2.25@2.75)	23.55	25.18
PITTSBURGH, including freight charge ($1.76) from the Valley		
No. 2 Foundry Valley (silicon 1.75@2.25)	20.26	19.51
Basic	19.76	19.76
Bessemer	21.26	20.76

SCRAP—The prices following are f.o.b. per ton paid by dealers:

	New York	Chicago	Birmingham
No. 1 railroad wrought	$11.50@$12.00	**$11.50@$12.00**	$11.00@$12.00
Stove plate	8.50@ 9.75	**13.00@ 13.50**	13.00@ 14.00
No. 1 machinery cast	15.00@ 16.00	*15.00*@ 16.00	15.00@ 16.00
Machine shop turnings	6.50@ **7.00**	**7.00@ 7.75**	8.00@ 8.50
Cast borings	**7.00**@ 7.50	**9.00@ 9.50**	8.00@ 8.50
Railroad malleable	10.75@ 11.25	**12.50@ 13.00**	12.00@ 13.00
Re-rolling rails	*10.25*@ *10.75*	13.00@ 13.50	15.00@ 16.00
Re-laying rails	23.00@ 24.00	.....	22.00@ 23.00
Heavy melting steel	*6.75*@ *10.85*	**11.75@ 12.25**	12.00@ 12.25

Railway Supplies

STEEL RAILS—The following quotations are per ton f.o.b. for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Aug. 4	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$43.00	$43.00	$43.00	.....
Standard openhearth rails	43.00	43.00	43.00	43.00	*$49.50*
Light rails, 8 to 10 lb.	.....	.....	34@36	1.80@1.90*	*1.90**
Light rails, 12 to 14 lb.	*34*@36	.....	34@36	1.80@1.90*	*1.80**
Light rails, 25 to 45 lb.	36.00	34@35	34@36	1.80@1.90*	*1.78**
Re-rolled rails	*30*@34	**28@30**	.....	34@36	17@18

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, white oak, plain	$1.45	$1.83
Chicago, empty cell creosoted	1.85	2.45
Chicago, zinc treated	1.65	2.15
San Francisco, green Douglas fir	.84	1.14
San Francisco, empty cell creosoted, Douglas fir	1.70	2.25
St. Louis, white oak, plain	1.25	1.50
St. Louis, zinc treated	1.65	1.90
St. Louis, red oak, plain	1.15	1.40
St. Louis, sap pine-cypress	1.00	1.25
Birmingham, white oak	1.25	1.45

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh mill for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Aug. 4	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$2.80	$2.90	$3.55	$3.65	$3.85	$3.00
Track bolts	3.90	3.90@ 4.15	4.55	4.60	5.35	3.90
Standard section angle bars, splice bars or fish plates	2.75	2.75	3.40	3.75	4.00	*2.95*

Pipe

WROUGHT STEEL AND IRON PIPE—The following percentage discounts are to jobbers for carload lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT-STEEL PIPE—From warehouses at the places named the following discounts hold for welded steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	53%	54%	49%
2½ to 6 in. lap welded	48%	51%	46%
	Galvanized New York	**Galvanized Chicago**	**Galvanized St. Louis**
1 to 3 in. butt welded	39%	41%	36%
2½ to 6 in. lap welded	35%	38%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36—5% off.

CAST-IRON PIPE—The following are prices per net ton for Class B and heavier f. o. b. in car load lots:

	Birmingham	Burlington, N. J.	New York Aug. 4	New York One Year Ago
4 in.	*$38.00*	*$46.00*	*$48.60*	$55.60@57.60
6 in. and over	*34.00*	*42.00*	*44.60*	51.60@53.60
	Pittsburgh	**Chicago**	**St. Louis**	**San Francisco**
4 in.	*$46.50*	$46.20	*$48.60*	*$51.00*
6 in. and over	*42.50*	*42.20*	*39.60*	*47.00*

Gas pipe and Class "A," $4 per ton extra.

CLAY DRAIN TILE—The following prices are per 1,000 lin.ft.:

Size, In.	New York Aug. 4	New York One Year Ago	St. Louis	Birmingham	San Francisco	Dallas
3	$45.00	$45.00	.....	$45.00	.....	$73.00
4	56.00	55.00	*$35.00*	56.00	$76.50	110.00
5	.....	.....	.....	80.00	97.75	118.00
6	80.00	90.00	*65.00*	100.00	127.50	150.00
8	150.00	160.00	*150.00*	165.00	212.50	210.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.....	$0.072	$0.10	.....	$.088	$0.12	.....
4	.....	.072	.10	*$0.0875*	.088	.15	$0.15
5	.....	.099	.135	.....	.121	.18	.18
6	$0.24	.099	.21	*.1225*	.121	.21	.21
8	.38	.162	.315	*.20*	.198	.30	.325
10	.50	.2415	.45	*.28*	.315	.42	.476
12	.66	.3105	.54	*.36*†	.405	.56	.612
15	1.12†	.414	.75	*.60*†	.54	.92	1.02
18	1.62†	.575	.90	*.84*†	1.00	1.32	1.53
20	1.95†	.69	1.20	.....	1.20	.....	.....
21	.....	.805	.....	*1.12*†	1.40	.....	.....
22	2.60†	.92	*1.25*	.....	1.60	.....	1.564
24	2.92†	1.035	2.665	*1.44*†	1.80	2.16	2.04
27	4.65†	2.08	2.952	*2.45*†	2.75	3.00	3.34
30	5.16†	2.304	3.96	*3.00*†	3.75	3.60	4.06
33	6.98†	4.05	4.51	*3.55*†	4.50	.....	4.99
36	8.00†	4.6125	*4.6125*	*3.95*†	5.00	.....	5.42

	3	5	8	12	24	36
Boston	*$0.12*	*$0.175*	$0.25	*$0.47*	*$1.80*†	$5.10†
Minneapolis	.....	.....	.25	.45	1.50	4.56
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.14	.....	.35	.63	2.52	.....
Los Angeles	.1675	.186	.2825	.5085†	2.034†	.....
New Orleans	.....	.....	.205	.40	2.27	3.50
Cincinnati	.105	.1575	.245	.4725	1.575	4.715
Atlanta	.10*	.15*	.25	.425	1.625	.....
Montreal‡	.....	.50	.70	1.50	6.00	.....
Detroit	.081	.122	.189	.405	2.07†	4.715†
Baltimore	.111	.166	.259	.499	1.665	4.92
Kansas City, Mo.	*.135*	*.15**	*.21**	*.52*	1.90†	3.80†
Philadelphia	.105	.15	.245	.40	1.40	3.50

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡Freight allowed.

Road and Paving Materials

ROAD OILS—Following are prices per gallon in tank cars, 8,000 gal. minimum f.o.b. place named:

		Aug. 4	One Year Ago
New York, 45% asphalt	(at terminal)	$0.0725@$0.075	$0.065 @$0.07
New York, 65% asphalt	(at terminal)	.0675@ .0725	.0675@.0725
New York, binder	(at terminal)	.07 @ .075	.07 @.075
New York, flux	(at terminal)	.07 @ .075	.07 @.075
New York, liquid asphalt	(at terminal)	.07 @ .075	.07 @.075
St. Louis, 40@50% asphalt		.052	.055
St. Louis, 50@60% asphalt		.0554	.0565
Birmingham, 55% asphalt		.0475	.0475
Dallas, 45% asphalt		.0495	.0495
Dallas, 50% asphalt		.0455	.0455
Dallas, binder		.061	.061
San Francisco, binder, per ton		12.00*	12.00*

* F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

E. N.-R. Prices of Construction Materials

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Texas*)	$24.50	.....
Boston (*Mexican*)	23.50	$19.00
Chicago (*Texas*)	23.00	18.50
San Francisco, *f.o.b. refinery*, Oleum, Cal	18.00	12.00
Dallas (*Texas*)	27.10	21.10
Seattle, "*D*" *grade, California, f.o.b. Richmond*	19.50	13.50
Denver (*California*)	24.00	.....
Minneapolis, *f.o.b. Twin Cities* (*Standolind*)	28.10	22.10
St. Louis (*Mexican*)	26.00	23.00
Baltimore (*Standard Oil*) (*f.o.b. refinery*)	22.50	18.50
Montreal (*Imperial*)	27.00	22.50
Atlanta (*Mexican*)	24.40	19.40
Detroit (*Mexican*)	24.00	19.00
Cincinnati (*Kentucky Rock*)	.....	11.65
Maurer, N. J. (*Bermudez*)	30.00	.....
Maurer, N. J. (*Trinidad*)	23.00	.....
Philadelphia (*Mexican*)	20.00	18.00
Kansas City, Mo. (*Texas*)	27.00	22.00
Los Angeles ("*D*" *grade, California*)	*18.00	*12.00
Birmingham (*Mexican*)	27.00	21.00
New Orleans (*Mexican*)	20.00	17.00

*F.o.b. El Segundo Refinery. Drums used in New York.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade I)	5-in. granite, 30 blocks per sq.yd.	$150.00 per M.
San Francisco	Basalt block 4x7x8	70.00 per M.
Chicago	about 5x8x5 dressed	3.60 per sq.yd.
	about 5x8x5 common	3.25 per sq.yd.
Boston	5-in. Granite	135.00 per M.
Atlanta	Granite	2.50 per sq.yd.
Detroit	5-in. Granite	3.00 per sq.yd.
Blatimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4x8x4	2.75 per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	Granite, 4x8x4	1.65 per sq.yd.
Kansas City	Granite	3.85 per sq.yd.
Philadelphia	Granite	3.90@4.25 per sq.yd.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft. wide	$0.24 per sq.ft.
	Manhattan, 4 ft. wide	.24 per sq.ft.
	Queens, 5 ft. wide	.26 per sq.ft.
	6x24-in. cross-walk	1.30 per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5x16 in., 90c.; *St. Louis*: Class "A" straight, delivered, 5x18 in., 90c. per lin.ft., roundings, $1.55. *Birmingham*: Limestone, 5x18-in., $1.05 per lin.ft.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq. Yd.
New York	3	16	$2.40
New York	3½	16	2.70
Boston	3½	18	2.40
Chicago	4	16	2.25
Chicago	3½	16	2.10
St. Louis	3½	16	*2.25*
St. Louis	4	16	*2.50*
Seattle	4	16	Off market
Minneapolis	3½	16	2.50
Atlanta	3½	16	2.00
New Orleans	3	16	2.20
New Orleans	3½	16	2.30
New Orleans	4	16	2.40
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4.50
Detroit	3	16	1.94
Cincinnati	3½	16	2.35
Kansas City	4	16	2.50
Philadelphia	4	16	None used

Construction Materials

SAND AND GRAVEL—Price for cargo or carload lots to contractor, f.o.b., per cu.yd.; weight of sand 1½ tons per cu.yd., gravel, 1½ tons per cu.yd.

	Gravel				Sand	
	1½ In.		¾ In.			
	Aug. 4	One Year Ago	Aug. 4	One Year Ago	Aug. 4	One Year Ago
New York (*alongside dock*)	$1.75	$1.75	$1.75	$1.75	$1.00	$1.00
Denver	1.90	1.90	1.90	1.90	1.00	1.00
Chicago	2.00*	1.60	2.00*	1.60	2.00*	1.40
St. Louis	1.45†	1.45†	1.45†	1.45†	1.20†	1.08†
Seattle	1.25	1.50	1.25	1.50	1.25	1.50
Dallas	2.38*	2.38*	2.38*	2.38*	2.00*	2.00*
Minneapolis	1.65‡	1.65‡	1.65‡	1.65‡	1.25	1.25
Cincinnati	1.30†	1.30†	1.30†	1.30†	1.05†	1.05†
San Francisco	1.80	1.80	1.80	1.80	1.40	1.40
Boston (*on trucks at dock*)	1.75†	1.50†	1.75†	1.50†	1.25†	1.00†
New Orleans	2.10†*	3.00†*	2.60†*	3.00†*	1.80†	1.80†
Los Angeles	2.00†*	1.15†	2.00†*	1.15†	1.40†	1.10†
Atlanta	2.20†	1.90†	2.20†	1.90†	1.40†	1.50†
Detroit	1.70	1.45	1.60	1.35	1.35	1.10
Baltimore	1.40	1.40	1.60	1.60	.70‡†	.70‡†
Montreal	1.90†	1.25†	1.90†	1.50†	1.35†	1.25†
Birmingham	2.00*	2.00*	2.00*	2.00*	1.50	1.45
Philadelphia	2.25*	2.10*	2.25*	2.10*	1.65	1.50
Kansas City, Mo.	.....	.....	.....	.....	.66‡†	.66‡†
Pittsburgh	.85‡	.....	.85‡	.....	1.25	.....

*Delivered †Per ton. ‡At pit.

CRUSHED STONE—Price for cargo or carload lots, per cu.yd., f.o.b. cars as follows:

	1½ In.		¾ In.	
	Aug. 4	One Year Ago	Aug. 4	One Year Ago
New York	$1.75	$1.75	$1.85	$1.85
Chicago	2.00†	1.70	2.00†	1.87½
St. Louis	1.83*	1.83*	1.83†	1.93*
Dallas	2.40†	2.40†	2.83†	2.83†
San Francisco	1.70	1.70	1.70	1.70
Boston (*on trucks at dock*)	2.00*	1.60*	2.00*	1.60*
Minneapolis	1.75	1.75	1.75	1.75
Kansas City	2.00	2.00	2.00	2.00
Denver	2.50†	2.50†	2.50†	2.50†
Seattle	3.00†	3.00†	3.00†	3.00†
Atlanta	2.50*†	2.50*†	2.50*†	2.50*†
Cincinnati	1.65*	1.65*	1.65*	1.65*
Los Angeles	2.00*†	1.40*	2.00*†	1.40*
Detroit	2.60*†	2.00*†	2.60*†	2.00*†
Baltimore	2.50†	2.45†	2.55†	2.50†
Montreal	1.80*	1.80*	2.00*†	1.70*
Philadelphia	2.25†	2.10†	2.25†	2.10†
Pittsburgh	2.75†	2.85†	2.75†	2.85†
Cleveland	2.70*†	2.70*†	2.70*†	2.70*†
Birmingham	2.60†	2.00†	2.00†	2.00†

* Per ton. † Delivered.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plant:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1.30
Buffalo District	1.25	1.35	2.25	1.25
Birmingham, Ala.	.90	1.25	2.05	.80
Cleveland, Ohio	1.20	1.20	.....	1.30*
Eastern Pa. and Northern N. J.	1.25	1.25	2.00	1.25
Western Pennsylvania	1.25	1.25	2.00	1.25
Toledo, Ohio	1.25	1.25	1.50	1.25

*Includes freight charge.

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$18.20	$11.00	$3.50*	$2.10@3.00*
Chicago	20.00	18.00	.....	1.50†
St. Louis	23.50	17.50	.....	2.03*
Boston	18.25	11.00	3.50*	2.10@3.00*
Dallas	19.00	.....	.....	1.82†
Cincinnati	16.80	11.90	.....	11.40‡
San Francisco	27.50	24.00	.....	1.70†
Minneapolis	25.50	21.00	.....	1.70†
Denver	24.00	.....	.....	2.70*
Detroit	15.50	11.50	.....	12.00‡
Seattle, *paper sacks*	24.00	.....	2.80†	.....
Los Angeles	26.00	18.00	2.40†	14.00‡
Baltimore	24.25	17.85	.....	.....
Montreal	.....	21.00	.....	10.00‡
Atlanta	24.50	13.50	.....	1.50†
New Orleans	24.00	17.00	2.60†	2.50*
Philadelphia	23.00	15.00	.....	.....
Kansas City	19.00	14.00	2.75†	2.50*
Birmingham	22.50	16.00	2.40†	1.85†

*Per 280-lb. bbl. (net). †Per 180-lb. (net). ‡ Per ton.

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, exclusive of bags:

	Aug. 4	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.35	1.50
Cincinnati (Utica)	1.72	1.72
Boston (Rosendale)	2.00	2.60
St. Louis (Carney)	2.85	2.35
Birmingham (Magnolia) pozzolan cement	2.40	2.40

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Aug. 4	One Month Ago	One Year Ago
New York, del. by truck	$2.35	$2.35@$2.50	$2.50@$2.60
New York, alongside dock to dealers	2.03	2.03	2.15
Jersey City	2.13	2.13	2.33
Boston	2.05	2.00	2.30
Chicago	2.05	2.05	2.10
Pittsburgh	2.04	2.04	2.09
Cleveland	2.24	2.24	2.29
Detroit	2.15	2.15	2.15
Indianapolis	2.19	2.19	2.29
Milwaukee	2.20	2.20	2.25
Duluth	2.04	2.04	2.09
Peoria	2.22	2.22	2.27
Cedar Rapids	2.24	2.24	2.34
Davenport	2.24	2.24	2.29
St. Louis	2.05	2.05	2.20
San Francisco	2.51	2.51	2.31
New Orleans	2.50	2.40	2.30
Minneapolis	2.22	2.22	2.32
Denver	2.85	2.85	2.85
Seattle	2.65	2.65	2.65
Dallas	2.05	2.05	2.05
Atlanta	2.40	2.40	2.35
Cincinnati	2.32	2.32	2.37
Los Angeles	2.56	2.56	2.30
Baltimore	2.50	2.50	2.35
Birmingham	2.40	2.40	2.40
Kansas City, Mo.	2.07	2.10	2.02
Montreal	2.22	1.22	1.15
Philadelphia	2.40	2.40	2.41
St. Paul	2.22	2.22	2.32
Toledo	2.20	2.20	2.20

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind	$1.80	Hudson, N. Y.	$1.75
Universal, Pa.	1.80	Leeds, Ala.	1.65
Steelton, Minn.	1.85	Hannibal, Mo.	1.90
Fordwick, Va.	2.05	Lehigh Valley District	1.75
Mitchell, Ind.	1.90	Wyandotte, Mich.	1.90
Iola, Kan.	1.85	Alpena, Mich.	1.75
Mason City, Ia.	1.80	Kingsport, Tenn.	2.05
La Salle, Ill.	1.90		

E. N.-R. Prices of Construction Materials

TRIANGLE MESH—Price per 100 sq.ft. in carload lots at mills; from warehouse in less-than-carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago District Mill	Warehouse: New York	St. Louis	Dallas	San Francisco
032	22	$0.99	$1.01	$1.39	$1.06	$1.13	$1.22
049	28	1.26	1.29	1.76	1.35	1.38	1.55
068	35	1.54	1.58	2.16	1.66	1.67	1.91
093	45	1.98	2.03	2.77	2.13	2.00	2.46
126	57	2.45	2.51	3.45	2.63	2.55	3.03
153	68	2.92	2.99	4.11	3.14	3.15	....
180	78	3.35	3.43	5.70	3.60	3.47	....
245	103	4.43	4.53	6.21	4.75	4.58	....
287	119	5.12	5.24	7.19	5.50	5.26	6.35
336	138	5.93	6.07	8.35	6.37	6.11	....
395	160	6.88	7.04	9.65	7.38	7.12	....
			PAVING				
036P	17	$0.76	$0.77	$1.06	$0.81	$0.76	....
053P	24	1.07	1.09	1.50	1.14	1.07	....
072P	31	1.35	1.38	1.90	1.45	1.39	....
097P	40	1.74	1.78	2.45	1.87	1.90	....
049R	24	1.07	1.09	....	1.14	1.02	....
067R	31	1.35	1.38	....	1.45	1.39	....
089R	40	1.74	1.78	....	1.87	1.90	....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq.ft.

EXPANDED METAL LATH—Prices in less-than-carload lots per 100 yd. for painted:

Weight in pounds	New York	Birmingham	Chicago	St. Louis	San Francisco	Dallas
2.2	$17.50	$19.50	$17.50	$16.50	$17.00	$24.00
2.5	18.50	21.50	18.50	17.50	19.00	26.00
3.0	21.00	24.50	21.00	20.00	22.00	29.00
3.4	22.50	27.50	22.50	21.50	24.00	31.00

BARS, CONCRETE REINFORCING—Current quotations per 100 lb., in carload lots, f.o.b., except at New York and St. Louis warehouses:

ROLLED FROM BILLETS

Inches	Pittsburgh	Birmingham	Warehouse: New York	Chicago	St. Louis	Dallas	San Francisco
¼ and larger	$1.80	$2.00	$3.24	$2.30@$2.50	$3.15	$2.75	$2.95
⅜	1.90	2.10	3.34	2.40@2.60	3.25	2.85	3.05
½	2.00	2.20	3.44	2.50@2.70	3.35	2.95	3.15
⅝	2.20	2.40	3.64	2.70@2.90	3.55	3.10	3.35
¾	2.80	3.00	4.24	3.30@3.50	4.15	3.75	3.95

For standard classification of extras for size and cutting of steel bars, see bar card of July 15, 1923.

ROLLED FROM RAILS

	St. Louis	Dallas		St. Louis	Dallas
¼ in and larger	$2.25	$2.48	⅝	$2.65	$2.88
⅜	2.35	2.58	¾	3.25	3.48
½	2.45	2.68	....	....	....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Aug. 4	One Month Ago	One Year Ago	Paving Brick: 3-inch*	3½-inch*
New York (del.)	$17.00	$17@19	$20.40@22.40	$45.00†	$51.00†
New York (at dock)	12@14	14@16	17@19	....	....
Chicago	12.00	12.00	12.00	42.00	45.00
St. Louis, salmon (del.)	15.00	15.00	16.00	40.00	42.50
Denver, salmon	8@12	9@10	10@12	....	....
Dallas	13.60	13.60	14.10	35.00	....
San Francisco	14.00	14.00	15.00	....	....
Los Angeles	10.00	10.00	9.00	(not used)	
Boston (del.)	19.75	20.00	18.50	45.00	50.00
Minneapolis (del.)	13.75	13.75	13.75	....	....
Kansas City	12.50	14.00	13.50	(no market)	
Seattle	14.00	14.00	15.00	....	55.00
Cincinnati	15.50	15.50	15.50	40.00	45.00
Montreal	20.25	20.25	17.50	100.00‡	....
Detroit (del.)	14.00	14.00	16.00	38.40	41.50
Baltimore	18.00	18.00	18.00	40.00	45.00
Atlanta	12.50	12.50	10.50	40.00	....
New Orleans	14.50	15.00	15.00	60.00	75.00
Birmingham	14.50	14.50	14.50	40.00	45.00
Philadelphia	18.00	18.00	19.00	40.00	50.00
Pittsburgh (del.)	17.00	17.00	16.00	....	....
Cleveland	14@16	14@16	12@14	....	....

*For paving blocks 3x8½x4 and 3½x8½x4 respectively. †In cars. ‡Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Aug. 4 on Trucks*†	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco†	Perth Amboy N. J., Factory*
4x12x12	$0.1027	$0.1112	$0.076	$0.105	$0.068	$0.108	....
6x12x12	.1541	.1667	.104	....	.09	.156	....
8x12x12	.1926	.2084	.142	.21	.126	.244	....
10x12x12	....	....	.182	....	.158	....	$0.2388
12x12x12	....	....	.202	.32	.186	....	.2956

*5 per cent off for cash. †Partition tile.

	4x12x12	8x12x12	12x12x12
Boston	$0.08	$0.145	$0.245
Minneapolis (f.o.b. cars)	.072	.13	.225
Cincinnati	.064	.1295	.1726
Kansas City	.088	.158	.242
Denver	.085	.155	.22
Seattle	.10	.18	.26
Los Angeles	.085	.172	.285
New Orleans	.11	.205	.31
Detroit	.0707	.1326	.1853
Montreal	.10	....	....
Baltimore	.124	.268	....
Atlanta	.0724	.1358	....
Dallas	.103	.19	.31
Birmingham	.11	.124	.255
Pittsburgh	.068	.128	.179
Cleveland	.07	.12	....

STRUCTURAL MATERIAL—Following are base prices per 100 lb. in carload lots, f.o.b. mill, Pittsburgh and Birmingham, together with quotations in less-than-carload lots from warehouses at places named:

	Pittsburgh	Birmingham	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$1.80	$1.90@$2.00	$3.34	$4.00	$3.25	$3.10	$3.10
Channels, 3 to 15 in.	1.80	1.90@2.00	3.34	4.00	3.25	3.10	3.10
Angles, 3 to 16 in., ¼ in. thick	1.80	1.90@2.00	3.34	4.00	3.25	3.10	3.10
Tees, 3 in. and larger	1.80	1.90@2.00	3.34	4.00	3.35	3.10	3.10
Plates, ¼ in. thick and heavier	1.80	1.90@2.00	3.34	4.00	3.25	3.10	3.10

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Warehouse: Pittsburgh Mill	New York: Aug. 4	New York: One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in.	$2.75@$3.00	$5.00	$4.20	$3.50	$3.75	$5.00	$4.75
		CONE HEAD BOILER					
½ in.	$3.10@$3.35	....	$4.40	$3.70	$3.90	$5.50	$5.00
⅝ and ¾	3.25@3.50	....	4.55	3.80	4.10	5.65	5.15
⅞ and 1	3.50@3.75	....	4.80	4.05	4.15	5.85	5.50

NAILS—The following quotations are per 100 lb. keg from warehouse:

	Pittsburgh Mill	Birmingham	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.55	$2.85	$2.95	$3.45	$4.25	$2.83	$4.95
Cut	2.80	2.90	....	5.00	5.00	2.95	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco: Galv	San Francisco: Black	Seattle Black
⅜	$7.50	$5.75	$7.75
½	7.05	5.30	5.65
⅝	6.90	5.15	5.50

Pittsburgh base in lots of 200 kegs or more, $3.30.

PREPARED ROOFINGS—Slate-surfaced roofing in rolls weighing 85 to 90 lb. costs $1.93½ per square to contractors in carload lots f.o.b. New York.

Single shingles, slate finish, cost $5.62½ per square (sufficient to cover 100 sq.ft.) in carload lots, f.o.b. New York. Strip shingles (4 in 1) f.o.b. New York, in carload lots to contractors, $4.27½ per square for the hexagonal shape, with Underwriters' label.

ROOFING MATERIALS—Prices f.o.b. New York, to contractors in carload lots:

Tarred felt per 100 lb	$2.94½
Asphalt coating, per gal	31½
Asphalt felt, per 100 lb	3.09

WINDOW GLASS—United inches, 25, bracket size 6x8 to 10x15, single thickness "AA," 83 per cent; "A," 88 per cent; "B," 89 per cent. Double thickness "AA," 83 per cent; "A," 88 per cent; "B," 89 per cent discount from jobbers list at New York warehouses.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.25	$3.60	$3.50	$3.85	$3.89
No. 12	2.30	3.65	3.55	3.90	3.94
No. 14	2.35	3.70	3.60	3.95	3.99
No. 16	2.45	3.80	3.70	4.05	4.09
Black					
Nos. 18 to 20	2.80	4.25	3.75	4.70	4.00
No. 22	2.95	4.40	3.90	4.85	4.15
No. 24	3.00	4.45	3.95	4.90	4.20
No. 26	3.10	4.55	4.05	5.00	4.30
No. 28	3.25	4.70	4.20	5.15	4.45
Galvanized					
No. 10	3.15	4.55	4.10	4.75	4.25
Nos. 12 to 14	3.25	4.65	4.20	4.85	4.35
No. 16	3.35	4.75	4.30	4.95	4.45
No. 18	3.50	4.90	4.45	5.10	4.60
No. 20	3.65	5.05	4.60	5.25	4.75
No. 22	3.70	5.10	4.65	5.30	4.80
No. 24	3.85	5.25	4.80	5.45	4.95
No. 26	4.05	5.50	5.05	5.70	5.20
No. 28	4.30	5.75	5.30	5.95	5.45

For galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per 7½-lb. gallon for raw oil:

	New York: Aug. 4	New York: One Year Ago	Chicago: Aug. 4	Chicago: One Year Ago
Raw in barrels (5 bbl. lots)	$0.84	$0.94½	$0.83½	$0.95

E. N.-R. Prices of Construction Materials

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b. New York:

	Dry		In Oil	
	Aug. 4	1 Yr. Ago	Aug. 4	1 Yr. Ago
Red	$13.75	$15.25	$15.25	$16.75
White	13.75	15.25	13.75	15.25

Lumber

Prices wholesale, per M. ft. b.m., in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to contractors at yards.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$26.00	$27.00	$28.00	$31.00
3x6 and 8	26.00	27.00	28.00	31.00
4x4-6 and 8	26.00	27.00	28.00	31.00
3x10 and 12	26.00	27.00	28.00	31.00
3x14	30.00	30.00	32.00	34.00
4x10 and 12	26.00	27.00	28.00	31.00
4x14	30.00	30.00	32.00	34.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$28.00	$30.00	$32.00
6x14	34.00	36.00	38.00
8x10	28.00	30.00	32.00
8x14	34.00	36.00	38.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York		Chicago	
	20 Ft. and Under L.L.Y.P.	22-24 Ft. L.L.Y.P.	20 Ft. and Under No. 1 L.L.Y.P.	Up to 32 Ft. No. 1 Douglas Fir
3x4 to 8x8	**$43.00**	**$44.00**	$38.00	*$39.00*
3x10 to 10x10	**50.00**	**51.00**	45.00	*39.00*
3x12 to 12x12	**57.00**	**58.00**	54.00	*39.00*
3x14 to 14x14	**65.00**	**66.00**	.....	*39.00*
3x16 to 16x16	**77.00**	**78.00**	.....	*40.50@41.00*

New York—Wholesale price of long-leaf yellow pine timbers (rough) to dealers; to contractors, delivered from lighters to job, $5@$10 additional. Short-leaf pine costs $3 per M. ft. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 32 ft. and $1 for each additional foot from 32 to 36 ft.

Other Cities

	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir*	Hemlock	Spruce	P.	Fir*
Boston	$48.00	$47.50†	$50.00	$52.00	$58.00	$57.50†
Seattle	.....	24.00	.....	.....	.....	23.00
New Orleans	36.00	.....	.....	.....	43.00	.....
Baltimore	32.50	49.25	53.00	60.00	65.00	49.75
Cincinnati	37.00	73.00	73.00	85.00	48.00	77.00
Montreal	50.00	55.00	.....	.....	60.00	50@55
Los Angeles	.....	32.00	.....	.....	.....	32.00
Denver	.....	33.25	34.25	34.25	.....	34.25
Minneapolis	42.50	38.75	34.50	.....	47.00	39.75
Atlanta	31.00	.....	.....	.....	34.00	.....
Dallas	56.00	.....	.....	.....	56.00	.....
Kansas City, Mo.	*41.50*	**39.75**	.....	.....	**55.50**	*40.25*
Birmingham	32.00	.....	.....	.....	34.00	.....
Philadelphia	48.00	36.00	38.00	45.00	62.00	36.00
Detroit	*44.00*	*41.50*	.....	.....	*55.00*	*41.50*
St. Louis	*39.00*	.....	.....	.....	*51.00*	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir*	Hemlock	P.	Fir*
Boston	*$48.50*	$43.00†	$45.00	*$48.50*	$48.00†
Seattle	.....	22.00	.....	.....	23.50
New Orleans	38.00	46.00	.....	28.00	34.00
Baltimore	55.00	44.00	44.00	34.00	50.00
Cincinnati	70.00	79.00	75.00	38.00	85.00
Montreal	45.00	55.00	40.00	65.00	50.00
Los Angeles	.....	24.50	.....	.....	36.00
Denver	.....	*32.75*	33.25	.....	*32.25*
Minneapolis	40.50	36.25	34.75	35.50	35.00
Atlanta	22.00	.....	.....	28.00	.....
Dallas	52.25	.....	.....	56.00	.....
Kansas City, Mo.	**49.25**	**39.75**	.....	*40.00*	*34.25*
Birmingham	27.00	.....	.....	45.00	.....
Philadelphia	30.00	36.00	36.00	52.00	36.00
Detroit	40.50	37.00	.....	44.00	41.25
St. Louis	*38.00*	.....	.....	28.00	.....

*Douglas fir. †Prime.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York:

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

Miscellaneous

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Aug. 4	One Month Ago	One Year Ago
$2.20@$2.25	$2.20@$2.25	$2.25@$2.30

CONCRETE BLOCKS—Standard 8x8x16-in., delivered to job, each:

Denver	$0.22	St. Louis	$0.21
Detroit	.16	Boston	.18@.20
New Orleans	.....	Minneapolis	.14*
Brooklyn and Queens	.18@.20	Philadelphia	.18@.20
Pittsburgh	.18		

*F.o.b.

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington: Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft.; ⅜-in., 6; ½-in., 4½; ⅝-in., 3½; ¾-in., 2 ft. 10 in.; 1-in., 2 ft. 4 in. Following are prices per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.24	New Orleans	$0.21
New York	.24½	Los Angeles	.25
Chicago	.23	Seattle	.23
Minneapolis	.25	St. Louis	.22½
San Francisco	.22½	Montreal	.17
Atlanta	.27	Detroit	.24½
Denver	.25@.26	Baltimore	.18
Cincinnati	.21	Kansas City	.25
Dallas	.31	Birmingham	.26@.27
Philadelphia	.25		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.265*	$0.2875*
Boston	.23	.25
Kansas City	**.2225**	**.2475**
Seattle	.165	.19
Chicago	.195†	.2175†
Minneapolis	.1917	.2123
St. Louis	**.22**	**.24½**
Denver	.2025	.2275
Dallas	.225	.306
Los Angeles	.1875	.2225
Atlanta	.23	.255
Baltimore	.22	.23
Cincinnati	.22	.245
Montreal	.1675	.1895
Birmingham	.22	.24
New Orleans	.235	.26
San Francisco	.1625	.1925
Philadelphia	.215	.24

*Special gelatin in case lots. †Quantities above 500 lb. and less than a ton

CHEMICALS—Water and sewage treatment chemicals, carload lots at New York:

Sulphate of aluminum, in bags, per 100 lb.	$2.00@$2.10
Sulphate of copper, in bbl., per 100 lb.	*4.90@5.00*
Soda ash, 58%, in bags, per 100 lb.	1.32½@1.37½
Chlorine, liquid, cylinders, per lb.	.05½@.08
Hypochlorite of lime (bleaching powder) in drums, per 100 lb.	2.00@2.10*

*F. O. B. Works.

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Atlanta	$0.58	Detroit	$0.29
Baltimore	.31	Kansas City	.735
Birmingham	.58	New Orleans	.67
Boston	.365	New York	.34
Buffalo	.265	Pacific Coast (all rail)	1.15*
Chicago	.34	Philadelphia	.32
Cincinnati	.29	St. Louis	.43
Cleveland	.19	St. Paul	.60
Denver	1.15*		

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.